

# Trade Liberalization and Embedded Institutional Reform: Evidence from Chinese Exporters\*

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## Abstract

When the removal of trade barriers coincides with the elimination of inefficient institutions created to manage them, the gains from trade increase. We investigate the change in productivity associated with the removal of quotas on Chinese textile and clothing exporters and the concomitant elimination of the institution which allocated the quotas. When quotas were abolished in 2005, Chinese export value and quantity surged and export prices declined. We show that these responses are due predominantly to the extensive margin: entrants gained market share at the expense of incumbent state-owned enterprises, and they entered with relatively low prices. These reactions are inconsistent with an ex ante assignment of quotas on the basis of firm productivity. We estimate that roughly half of the overall productivity gain among China's textile exporters following quota removal is due to the elimination of the quota licensing institution.

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## 1 Introduction

Standard models of international trade generally predict small welfare gains from trade liberalization (Arkolakis et al. 2010). Empirical research, on the other hand, often finds substantial increases in productivity or income coinciding with the removal of trade barriers (e.g., Pavcnik 2002 and Feyrer 2010). One explanation for this discrepancy is that removing a particular tariff or non-tariff barrier to trade also eliminates other (un-modeled) policy distortions that evolved to manage the trade barrier. The welfare losses associated with tariffs, for example, can be amplified by corrupt customs agents or bureaucratic “red tape” that substantially increases the time goods spend in transit.<sup>1</sup> If such policies influence how resources are allocated among existing firms, or favor incumbents at the expense of entrants, they can have a sizable effect on aggregate outcomes. Trade liberalization that removes both the trade barrier and the accompanying distortions can yield gains that are larger than the predicted benefit of removing just the trade barrier.

This paper estimates the productivity gain to China from the removal of a particular trade barrier, export quotas, and decomposes that gain into two parts: that which is due to the removal of the trade barrier itself versus that which is accounted for by the elimination of the inefficient export licensing institution that assigned the quotas. We analyze China’s textile and clothing industry before and after the January 2005 expiration of the global Agreement on Textiles and Clothing, previously known (and referred to in this paper) as the Multifiber Arrangement (MFA). Under the MFA, exports of textile and clothing products by China and other developing economies to the United States, the European Union and Canada were subject to quotas. In China’s case, the licenses permitting firms to export a portion of the country’s overall quota were distributed by the government according to a complex set of rules that may not have emphasized efficiency. We use firm-level Chinese trade data to examine how the distribution of textile and clothing exports changed within and across firms as quotas were removed, and to gauge whether these changes are consistent with an allocation of quotas to the most productive firms prior to their removal.

Our assessment of the efficiency with which China assigned export licenses is guided by a model of “efficient allocation”. This model is adapted from Irarrazabal et al. (2010), who introduce specific (i.e., per-unit rather than *ad valorem*) tariffs into the heterogeneous-firm framework of Melitz (2003) and Chaney (2008). Here, we interpret the specific tariff as a quota license fee which firms must pay in order to access restricted foreign markets. We assume that the government does not know the productivity of firms, but that it achieves efficient allocation by assigning export licenses via this (common) license fee. Firms self select into the quota-constrained export market based on their productivity, as only the most productive exporters remain profitable net of the fee. We also consider a model of “inefficient allocation”, where the government assigns export licenses to “politically favored” firms. In that model, the most productive firms do not necessarily receive quotas, and the contribution of the extensive margin to export growth following the end of the MFA is larger than under efficient allocation.

In the efficient allocation model, the exports of the most productive incumbents jump disproportionately once quotas are removed. This asymmetric reaction by the intensive margin is driven by removal of the per-unit license fees, which impose a greater distortion on high-productivity firms’ low-priced exports than low-productivity firms’ high-priced exports. The removal of export quotas may also cause less-productive firms to enter the export market: because obtaining a costly export license is no longer necessary, relatively unproductive firms may find it profitable to export the previously constrained goods. This potential contribution by the extensive margin depends upon the density of high-productivity firms. If it is high enough, the aggregate price decline associated with high-productivity firms’ post-quota growth can shut low-productivity entrants out of the export market, or even induce the lowest-productivity incumbents to exit the export market.

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<sup>1</sup>Djankov, Freund and Pham (2010) document substantial variation across countries in the time required to export a standard container. Sequeria and Djankov (2010) show that this variation is driven in part by institutions arising from trade barriers: firms choose to export through more distant ports if customs agents at nearby ports are more corrupt. Kaufmann and Wei (2000) show that, contrary to the hypothesis that bribery greases the wheels of commerce, red tape and bribery tend to be positively correlated.

Empirically, we employ a difference-in-differences strategy to examine how Chinese exporters react to the removal of quotas in 2005. In particular, we compare the pre- and post-January 2005 behavior of firms exporting quota-constrained textile and clothing products to exporters of very similar textile and clothing products that are exported quota free. This comparison isolates the effects of potential inefficient quota allocation from other factors that affect Chinese textile and clothing exporters more broadly. Exports of “cotton slips” (HS 62081920) to the United States, for example, were subject to quotas in 2004, while exports of “silk slips” (HS 62081910), were not. Contrasting their growth in the years before and after quotas are removed allows us to control for shocks to supply, such as privatization, or shocks to demand, such as changes in the preferences of consumers, that are common to both goods.

As documented by Harrigan and Barrows (2009), Brambilla et al. (2010) and Bernhofen et al. (2011), China’s exports of previously constrained textile and clothing products jump following quota removal, while their export prices decline. We find here that, in contrast with the implications of the efficient allocation model, both outcomes are driven by the extensive margin. Furthermore, three trends indicate that entrants are *more* productive than incumbents. First, entrants’ prices are on average 27 percent lower than incumbents, and they account for a large fraction of the overall 17 percentage point decline in relative prices. Second, incumbents with the highest market share under quotas experience the largest decline in market share when quotas are removed. Under efficient allocation, these incumbents possess the highest productivity and therefore should have benefited disproportionately from the removal of license fees. Finally, entrants emerge primarily from the private sector, and gain market share at the expense of state-owned enterprises (SOEs). As SOEs are well-known for their relatively low productivity (Dollar and Wei 2007, Brandt, Tombe and Zhu 2010), this trend suggests China’s quota-licensing institution favored relatively unproductive firms.

Back-of-envelope calculations suggest that the replacement of SOEs with privately owned firms following quota removal resulted in an 18 percent increase in aggregate TFP. This increase is substantial compared to the 9 percent growth implied by the decline of SOEs among exporters of non-quota-constrained textile and clothing goods in the same year. It is also large relative to the average 4 percent TFP growth of all non-agricultural firms in China over the 1998 to 2007 period found by Brandt and Zhu (2010). We quantify the relative contribution of the removal of the licensing institution using numerical solutions of the model that estimate productivity growth after quota liberalization assuming both efficient and inefficient *ex ante* allocation. We find that 44 percent of the overall productivity gain can be attributed the embedded institutional reform, with the remaining 56 percent due to the removal of the quotas themselves. These results suggest that gains from trade liberalization may be amplified substantially by the removal of inefficient institutions that grow up around them.

The results of this paper contribute to literatures in both economic development and international trade. Our analysis of how trade affects institutions complements research by Acemoglu, Johnson and Robinson (2005), who argue that the rise of international trade after 1500 increased the power of the merchant class and led to changes in institutions that increased their private property rights. Here, we provide an example of how the removal of trade barriers can lead to the automatic elimination of inefficient institutions that grew up around them. By quantifying this distortion, we contribute to the theoretical literature on the welfare consequences of poor policy implementation under the MFA (Krishna and Tan 1998), and Anderson’s (1985) analysis of similar inefficient allocation of U.S. cheese quotas in the early 1980s.

Our findings also relate to the growing set of papers that use micro-data to estimate the effects of market distortions on firms.<sup>2</sup> This research generally focuses on resource allocation among existing firms (i.e., the intensive margin).<sup>3</sup> Here, we focus on the extensive margin, and also identify misallocation using weaker assumptions. Hsieh and Klenow (2009), for example, assume identical production functions across time and countries in their comparison of firm productivity distributions in the United

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<sup>2</sup>See, for example, Hsieh and Klenow (2009), Dollar and Wei (2007), Restuccia and Rogerson (2010), Alfaro, Charlton, and Kanczuk (2008), Midrigan and Xu (2010), and Petrin and Sivadasan (2010).

<sup>3</sup>A recent exception is Chari (forthcoming) who analyzes the aggregate productivity effects of firm entry and size restrictions under India’s industrial licensing policy.

States, India and China. Cross-country comparisons in Alfaro et al. (2008) and Restuccia and Rogerson (2010), on the other hand, assume both that the U.S. allocation of factors is distortion free and that entrepreneurial ability is drawn from the same distribution across countries. However, if entrepreneurial ability is shaped by the economic environment (such as the quality of educational institutions), the distribution need not be identical across countries.<sup>4</sup> In the difference-in-differences strategy used here, by contrast, we only require the assumption of identical technology and entrepreneurial ability across similar types of textile and clothing products within China, e.g., silk versus cotton slips.

The effect of distortions on the extensive margin is studied most widely in the context of credit constraints in developing countries (Banerjee and Duflo, 2005). Banerjee and Duflo (2004), for example, use an exogenous change in the supply of credit to specific firms to identify constraints on obtaining credit among Indian firms. Their results suggest the existence of talented entrepreneurs who are unable to borrow from the formal banking sector. Recent theoretical contributions to this literature have shown that the potential effect of this extensive-margin misallocation on aggregate productivity could be quite large.<sup>5</sup> We find empirical evidence for these large effects in the context of a precisely defined government institution.

The rest of the paper proceeds as follows. Section 2 presents a model of efficient quota allocation that is used to guide the empirical analysis. Section 3 presents a brief summary of the Multifiber Arrangement. Section 4 performs the empirical analysis. Section 5 explores alternative explanations for our findings. Section 6 decomposes that gain into two parts: that which is due to the removal of the trade barrier itself versus the part accounted for by export licensing institution that managed the allocation of quotas. Section 7 concludes.

## 2 Theory

In this section we outline a simple, “efficient-allocation” model of exporting under quotas to guide our empirical analysis. We use this model to derive firm-level implications for how export quantities and prices respond to the removal of quotas assuming quota licenses are allocated to the most productive exporters.

The model delivers two key results. First, the removal of quotas can induce *less* productive firms to enter the export market. Second, even if this entry occurs, preponderance of export quantity increases and export price declines following quota removal is accounted for by incumbents. The intuition for these results is straightforward. With the elimination of quotas, potential exporters whose costs inclusive of the license fees were previously too high to attract enough foreign consumers to overcome the fixed costs of exporting can now enter the export market. However, the removal of license fees exerts a disproportionately large effect on low-price (high-efficiency) firms than high-price (low-efficiency) firms because they represent a larger fraction of high-efficiency firm’s low prices. In demonstrating these implications, we employ numerical solutions where analytic results cannot be obtained.

### 2.1 Exporting Under Quotas

Our model is a re-interpretation of Irarrazabal et al. (2010), which analyzes exporting by heterogeneous firms in a trading system where importing countries make use of both specific (i.e., per unit) and *ad valorem* tariffs. As in Demidova, Kee and Krishna (2009), we interpret quota license fees as equivalent to per-unit increases in the cost of exporting.

Irarrazabal et al. (2010) is an  $N$ -country version of Melitz (2003) that collapses to Chaney (2008) when specific tariffs are set to zero. We assume that in order to export a quota-bound good from origin

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<sup>4</sup>The fact that entrepreneurs in developing countries often do not adopt best practices (Bloom and Van Reenan 2007) may indicate that these “technologies” are slow to diffuse across countries.

<sup>5</sup>Banerjee and Moll (2010), for example, model misallocation due to financial frictions that prevent entrepreneurs from entering markets, while Buera and Shin (2008) and Buera, Kaboski and Shin (2010) quantify the role of financial constraints on productivity and growth in a related calibration exercise.

country  $o$  to destination country  $d$ , firms must pay  $a_{od} > 0$  per unit exported as well as an *ad valorem* tariff  $\tau_{od} > 1$  of the value of the product exported. Productivities are drawn from the distribution  $G(\varphi)$  with density  $g(\varphi)$ , and the price of variety  $\varphi$  in export market  $d$  is given by

$$p_{od}(\varphi, a_{od}) = \frac{\sigma}{\sigma - 1} \omega_o \left( \frac{\tau_{od}}{\varphi} + a_{od} \right), \quad (1)$$

where  $\sigma > 1$  is the constant elasticity of substitution across varieties and  $\omega_d$  is the wage in the home country.<sup>6</sup> The corresponding export quantities are given by

$$q_{od}(\varphi, a_{od}) = \left( \frac{\sigma}{\sigma - 1} \omega_o \right)^{-\sigma} \left( \frac{\tau_{od}}{\varphi} + a_{od} \right)^{-\sigma} (P_d)^{\sigma-1} Y_d \quad (2)$$

where  $P_d$  and  $Y_d$  are the price index and expenditure in the destination market, respectively.

In this efficient allocation model, a Walrasian auctioneer finds the license price by equating the aggregate demand for exports,  $\int_{\varphi^*} q_{od}(\varphi, a_{od}) g(\varphi) d\varphi$ , and the size of the quota,  $Q_{od}$ , where the latter is determined exogenously through bilateral negotiations between the origin and destination countries. This setup is similar to Anderson (1985), who demonstrates that the most efficient allocation of quotas implies a common license price. Lower license prices connote less restrictive quotas, and *vice versa*.

A productivity cutoff,

$$\varphi_{od}^* = \left[ \zeta \left( \frac{f_{od}}{Y_d} \right)^{\frac{1}{1-\sigma}} \frac{P_d}{\omega_o \tau_{od}} - \frac{a_{od}}{\tau_{od}} \right]^{-1}, \quad (3)$$

determines the marginal exporter who is indifferent between paying the fixed costs of exporting and remaining a purely domestic firm. In equation (3),  $\zeta = \left( \frac{\sigma-1}{\sigma} \right) \sigma^{\frac{1}{1-\sigma}}$  is a constant and  $f_{od}$  is the fixed costs of exporting from country  $o$  to country  $d$ .

As in Irarrazabal et al. (2010), there is no closed-form solution for the price index  $P_d = P_d(\varphi_{od}^*)$  when  $a_{od} > 0$ . With  $P_d$  fixed, it is easy to verify that a lower license price implies a lower cutoff for exporting,  $\frac{d\varphi_{od}^*}{da_{od}} > 0$ . If the exporting country is large, the foreign price index will fall with quota liberalization and, depending on the magnitude of the decline, the productivity cutoff  $\varphi_{od}^*$  could rise, implying that the least-productive exporters exit. To fix ideas, we assume for the remainder of this subsection that the exporting country is small relative to the importer and therefore that the price index is insensitive to changes in the license fee. In the numerical analysis below, we relax this restriction.

When license fees are zero, the ratio of output quantities between two firms with productivities  $\varphi > \varphi'$  is independent of *ad valorem* trade costs (Melitz, 2003). The existence of such fees, however, breaks this independence because per-unit costs disproportionately raise the price of low-price (high-productivity) firms compared to high-price (low-productivity) firms. As a result, with  $P_d$  fixed, reductions in the license fee induce relatively greater growth in export quantities among higher-productivity incumbents,

$$\frac{\partial \left[ \frac{q_{od}(\varphi, a_{od})}{q_{od}(\varphi', a_{od})} \right]}{\partial a_{od}} = -\sigma \left[ \frac{\frac{\tau_{od}}{\varphi} + a_{od}}{\frac{\tau_{od}}{\varphi'} + a_{od}} \right]^{-\sigma-1} \frac{\tau_{od} \left( \frac{1}{\varphi'} - \frac{1}{\varphi} \right)}{\left( \frac{\tau_{od}}{\varphi'} + a_{od} \right)^2} < 0. \quad (4)$$

Thus, while the entry of low-productivity firms causes the overall share of incumbents to fall with  $a_{od}$ , among incumbent firms the market shares of the largest and most productive firms rise. Removing the license fee contributes to a gain in weighted-average productivity because these high-productivity firms increase their market shares after liberalization.

The simple average productivity of exporters,  $\bar{\varphi}(\varphi^*)$ , is given by

<sup>6</sup>Since firms pay the additive fee and pass this fee on to customers, prices are a constant markup above marginal cost. This contrasts with Berman, Martin and Mayer (2009) who also introduce additive transport costs but have variable markups since the consumer pays the fee. Wages are pinned down by a perfectly competitive outside sector.

$$\bar{\varphi}(\varphi^*) = \frac{1}{1 - G(\varphi^*)} \int_{\varphi^*} \varphi g(\varphi) d\varphi. \quad (5)$$

With  $P_d$  fixed, the average productivity of exporters falls in response to quota liberalization,

$$\frac{\partial \bar{\varphi}}{\partial a} = \frac{g(\varphi^*)}{1 - G(\varphi^*)} \frac{\partial \varphi^*}{\partial a} [\bar{\varphi}(\varphi^*) - \varphi^*] > 0. \quad (6)$$

Intuitively, as the license price falls and  $\varphi^*$  declines, less-productive firms enter the export market, driving down the average productivity of all exporters. Given that an individual firm's productivity is fixed by assumption, there is no change in the average productivity of incumbents.

The response of *quantity-weighted* average productivity to quota reduction is more complex because it depends upon the redistribution of activity among incumbents,

$$\begin{aligned} \frac{\partial \bar{\varphi}}{\partial a} = & \underbrace{\frac{1}{1 - G(\varphi^*)} \int_{\varphi^*} \frac{\partial [q(\varphi)/Q]}{\partial a} \varphi g(\varphi) d\varphi}_{\text{Intensive}} \\ & + \underbrace{\frac{g(\varphi^*)}{1 - G(\varphi^*)} \frac{\partial \varphi^*}{\partial a} \left[ \bar{\varphi}(\varphi^*) - \varphi^* \frac{q(\varphi^*)}{Q} \right]}_{\text{Extensive}} \end{aligned} \quad (7)$$

The first term in equation (7) is the change in weighted-average productivity due to the intensive margin. The sign of this term is negative as reductions in the quota license fee increase the relative market share of high-productivity incumbents at the expense of low-productivity incumbents. The sign of the extensive-margin contribution, on the other hand, is positive: a reduction in the license price enables less efficient firms to commence exporting, which drives down the weighted average. The overall effect of a change in the license price on weighted average productivity is ambiguous. It is negative if the right tail of the distribution of firm productivity is relatively thin as low-productivity entrants will account for a larger fraction of growth. It is positive if incumbents account for a larger fraction of growth.

The model's one-to-one correspondence between productivity and price yields similar relationships with respect to export prices. The average price of exports is given by

$$\bar{p}(\varphi^*) = \frac{1}{1 - G(\varphi^*)} \int_{\varphi^*} p(\varphi) g(\varphi) d\varphi. \quad (8)$$

Here, the removal of quotas implies an *increase* in the average price of exports, net of the impact of removing the license fee

$$\frac{\partial \bar{p}}{\partial a} = \underbrace{\frac{\sigma}{\sigma - 1}}_{\text{Intensive}} + \underbrace{\frac{g(\varphi^*)}{1 - G(\varphi^*)} \frac{\partial \varphi^*}{\partial a} [\bar{p} - p(\varphi^*)]}_{\text{Extensive}}. \quad (9)$$

The sign of the first term is positive and represents the change in average price among incumbents due to the reduction of the license fee (see also equation (1)). The second term represents the change in the average price due to the extensive margin. This term is negative: as license prices fall, less efficient firms enter the market pushing up the average price. The key insight here is that only incumbents contribute to lower prices following quota reductions.

The response of quantity-weighted average export prices to reductions in the quota is given by

$$\begin{aligned}
 \frac{\partial \tilde{p}}{\partial a} = & \underbrace{\frac{1}{1 - G(\varphi^*)} \int_{\varphi^*} \frac{\partial [p(\varphi)q(\varphi)/Q]}{\partial a} \varphi g(\varphi) d\varphi}_{\text{Intensive}} \\
 & + \underbrace{\frac{g(\varphi^*)}{1 - G(\varphi^*)} \frac{\partial \varphi^*}{\partial a} \left[ \tilde{p}(\varphi^*) - \frac{q(\varphi^*)p(\varphi^*)}{Q} \right]}_{\text{Extensive}}
 \end{aligned} \tag{10}$$

The first term represents the intensive margin and its sign is positive: when license prices fall, the prices of all incumbent firms will fall. The extensive-margin term is negative, as less-productive entrants enter the market with relatively high prices. The overall change in the weighted-average export price is ambiguous: if the most productive incumbents market share rises enough, it falls, else it rises.

Our model of efficient allocation assumes constant product quality before and after quotas are removed. It is of course possible that firms decide to alter product quality as a result of the trade liberalization, i.e., that some of the price declines observed after quotas are removed might be driven by quality downgrading. We discuss how our empirical results might be interpreted in this more general setting in Section 5.3.

## 2.2 Numerical Solutions

We make use of numerical solutions of the “efficient allocation” model described above to derive implications for the price index  $P_d = P_d(\varphi_{od}^*)$  when  $a_{od} > 0$ .<sup>7</sup> For reasonable parameters values, these solutions yield predictions similar to those derived analytically above.

We consider two countries and one industry. We assume symmetric country sizes and set  $L_o = 100$  and  $L_d = 100$ . Iceberg trade costs are chosen so that the share of Chinese textile and clothing exports in U.S. imports and *vice versa* match the observed shares in 2005 (23 percent and 5 percent, respectively). This parametrization of the iceberg trade costs captures the fact that wages in the United States are higher than in China. The iceberg cost within each country is set to one, and we assume  $\sigma = 4$ , the median elasticity of substitution in apparel and textiles found by Broda et al (2006). We follow the literature in assuming firm productivity is Pareto distributed,  $G(\varphi) = 1 - \varphi^{-\gamma}$ . The shape parameter  $\gamma$  and the fixed cost of exporting are chosen to match the post-quota distribution of Chinese export value to the previously quota-constrained markets of the United States, Canada and the EU.<sup>8</sup> The calibration yields a shape parameter of 3.8 and a ratio of export fixed cost to domestic fixed cost equal to 2.<sup>9</sup>

Using these parameters, we solve for productivity cutoffs and price indexes in a “quota-free” equilibrium. We then re-solve the model under increasing levels of “quota restrictiveness”, which we define as 1 minus the ratio of exports under quotas to exports in the quota-free equilibrium. Quota restrictiveness varies from 0 to 1 as quotas move from non-binding to prohibitive. The relative growth of Chinese textile and clothing exports between 2004 and 2005 observed in Table 1, discussed in greater detail below, implies a quota restrictiveness of 0.58.

The solid curve in Figure 1 plots the home country’s change in average (exporter) productivity between an efficient allocation and the “quota-free” equilibrium as quota restrictiveness changes from 0 to 1. Consistent with the comparative static in equation (6), which relied on a fixed aggregate price

<sup>7</sup>We are grateful to Andreas Moxnes for providing the Matlab code used to derive the numerical solutions in Irarrazabal et al. (2010). We modify their code by adding the quota constraint and solving for an equilibrium license fee given this constraint.

<sup>8</sup>The share of exports accounted for by the 50th, 75th, 90th, 95th and 99th percentiles in 2005 are 2, 8, 16, 14, 29 and 31 percent, respectively. China’s Annual Survey of Industries reports that 45 percent of firms in the textile and clothing sectors (Chinese Industrial Classification 17 and 18) exported in 2005. We explore the implications of using alternative shape parameters and a lognormal productivity distribution in Section 6.

<sup>9</sup>By comparison, Bernard et al.’s (2007) analysis of comparative advantage among heterogeneous firms assumes  $\gamma = 3.4$ . We examine the sensitivity of our results to variation in  $\gamma$  in Section 6.

index, this curve is downward sloping: removal of more-restrictive quotas induces greater declines in average productivity because of greater entry by low-productivity firms.

The dashed curve in Figure 1, by contrast, traces out a positive relationship between quota restrictiveness and weighted-average productivity. As noted in the previous section, this relationship depends upon the extent to which the highest-productivity incumbents gain market share following quota removal. Given our parameters, we find that growth along the intensive margin following efficient allocation dominates: when quotas of restrictiveness 0.58 are removed, virtually all – 99 percent – of the growth in export quantity is accounted for by incumbents.

### 3 A Brief Summary of the MFA

China’s textile and clothing industry accounts for a substantial share of its overall economy. In 2004, it employed 12.9 million workers, or 13 percent of total manufacturing employment (2005 China Economic Census). China’s textile and clothing exports account for 15 percent of the country’s overall exports, and 23 percent of world-wide textile and clothing exports (which equaled \$487 billion dollars in 2005).

The Multifiber Arrangement (MFA) and its successor, the Agreement on Textile and Clothing (ATC), grew out of restraints imposed by the United States on Japanese imports during the 1950s. Over time, it evolved into a broader institution that regulated the exports of clothing and textile products from developing countries to the United States, EU, Canada (the “UEC”), and Turkey. (Though we are unable to locate the list of products under quotas in Turkey, they accounted for less than 0.5% of China’s textile and clothing exports in 2004.) Bargaining over these restrictions was kept separate from multilateral trade negotiations until the conclusion of the Uruguay Round in 1995, when the UEC agreed to eliminate the quotas over four phases. At the beginning of 1995, 1998, 2002 and 2005, the UEC were required to remove textile and clothing quotas representing 16, 17, 18 and the remaining 49 percent of their 1990 import volumes, respectively. The order in which goods were placed into a particular phase varied across importers, with each country generally choosing to place their most “sensitive” textile and clothing products into the final phase (Phase IV) to defer politically painful import competition as long as possible (Brambilla et al. 2010). This aspect of the liberalization suggests that the reaction of Phase IV exports relative to a control group is likely stronger than a similar comparison in earlier phases. However, the fact that Phase IV goods were determined in 1995 implies that their choice was not influenced by demand or supply conditions in 2005.

China did not become eligible for quota removal until it joined the WTO at the end of 2001. In early 2002, its quotas on Phase I, II and III goods were relaxed immediately. Removal of quotas on Phase IV goods – the focus of our empirical work – occurred according to schedule in 2005, and coincided with China’s agreement under the WTO to eliminate export licensing in all products by 2005. However, only 12 percent of non-quota textile and clothing products, accounting for only 5 percent of value, required export licenses in 2004.<sup>10</sup> To the extent that removal of export licensing promoted entry into these products in 2005, the *relative* contribution of entry into MFA product markets discussed in the next section will be biased downwards.

Like other countries under the MFA, China officially allocated quotas on the basis of past performance, i.e., firm’s ability to export their quota successfully in the previous year (Krishna and Tam 1998). China’s actual allocation of quotas, however, deviated from this principle, at times substantially (Moore 2002). In the 1980s, rent-seeking and political favoritism were rampant. The People’s Liberation Army (PLA), for example, received quotas in return for their support of the government, and these allocations were increased in 1989 following their backing of the state during the Tiananmen crisis. Likewise, the central Ministry of Commerce provided quota allocations to provincial authorities in an effort to promote the spread of textile and clothing manufacturing geographically (Ministry of Foreign Trade and Economic Cooperation, 2001).

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<sup>10</sup>The products that were subject to export restrictions are listed in China’s WTO accession document (WT/ACC/CHN/49).



Although trading quotas in China was illegal throughout the MFA, anecdotal evidence suggests that an active black market emerged during the 1980s. One consequence of this illegal trading was unused quota, which occurred when firms were unable to find a buyer for their quota.<sup>11</sup> To prevent quota from going unused, the government stepped up enforcement of allocations based on past performance, and tried to prevent non-producing firms from receiving quotas (Moore 2002). These reforms are generally believed to have reduced black-market activity, though verification of this claim is difficult given firms' (understandable) reluctance to discuss illegal trading (Moore 2002; interviews conducted by the authors). The potential sensitivity of our results to legal or illegal subcontracting, as well as empirical exercises designed to measure it, are discussed further in Section 5.1.

Starting in 2000, the government experimented with auctioning up to 30 percent of the total quota allocation of a subset of MFA goods. To bid in these auctions, however, firms were required to win approval from the government. Unfortunately, we have been unable to determine the precise criteria governing approval, though we do know that entry into the bidding process required official permission.

## 4 Reallocation of Chinese Exports Following Quota Removal

From the perspective of the efficient allocation model described in Section 2, we expect quota liberalization to coincide with three outcomes: a reallocation of market share towards the largest, most productive incumbent exporters under the quota institution; a reduction in incumbents' export prices due to the removal of license fees; and the entry of less-productive exporters with relatively high export prices. As discussed further in the counterfactual section below, an alternate hypothesis of "inefficient allocation" implies a stronger role for the extensive margin.

### 4.1 Data

Our empirical analysis relies on data from several sources. The first is Chinese customs data by firm, eight-digit Harmonized System (HS) category and destination country. For each firm-product-country observation, we observe the total nominal value and quantity exported as well as whether firms fall into one of three ownership categories: state-owned enterprises ("SOEs"), domestically owned private firms ("domestic") and foreign-owned private firms ("foreign").<sup>12</sup> Quantity units are available for 99 percent of observations representing 99 percent of export value, and vary across products, e.g., square meters of fabric. We combine the value and quantity data to construct nominal unit values, also referred to as "prices". As documented in Schott (2004), unit values can be noisy and we therefore follow the literature in trimming outliers for some of our results as noted below.

We partition China's exports into six mutually exclusive and time-invariant "groups" based on destination market and product type. Destination markets fall into two blocs: the first encompasses the United States, the members of the European Union and Canada and is referred to as "UEC"; the second bloc contains all other countries and is referred to as "rest of the world" or "ROW".<sup>13</sup> Within a country, products are partitioned into three types: textile and clothing products subject to a quota prior to 2005 (MFA), other textile and clothing products not subject to a quota (OTC), and non-textile and clothing products, e.g., electronics or steel (NTC).<sup>14</sup>

<sup>11</sup>Although 2004 was the final year of the MFA, there is anecdotal evidence that firms believed that quotas would be reimposed in subsequent years which would mitigate their incentives to subcontract in this year.

<sup>12</sup>The customs data separate firms into seven groups. We classify "state-owned" firms as SOEs; "collective-owned", "other" and "private domestic" firms as domestic, and "foreign-exclusive owned" and two joint venture classifications as foreign.

<sup>13</sup>We treat the EU as a single block of countries throughout our analysis given that quotas are set for the union as a whole.

<sup>14</sup>Phase I, II and III products, whose quotas were removed prior to 2005, are classified as OTC goods in our analysis. We note that changes to China's export classification scheme each year results in small changes to the number of products in each type between 2000 and 2005. The set of textile and clothing products are: two-digit HS chapters 50-63; four-digit HS chapter 6406; five-digit HS chapters 30059 and 65059; six-digit HS chapters 701919 and 94049. We identify the quota products among these based on a concordance made available by the Embassy of China's Economic and Commercial

A given product-country is assigned to one of the six resulting  $\{NTC, OTC, MFA\} \times \{ROW, UEC\}$  groups. MFA-UEC, for example, refers to product-country exports that are subject to quotas, while OTC-UEC encompasses product-country exports of textile and clothing products not subject to quotas. Note that our classification is product-country specific. As a result, it is possible for a given HS product to be part of two different groups. For example, a textile and clothing product subject to a quota only in the United States *to the United States*, is MFA-UEC, but if it is exported *to the EU*, is OTC-UEC.<sup>15</sup> Among the 554 products that are subject to quotas by any of the three countries of UEC in 2004, 163 are subject to quotas by all three destinations, while 160, 50, and 6 are subject to quotas solely in the United States, solely in the EU and solely in Canada, respectively.

We assess the efficiency of China’s quota allocation by examining changes in MFA-UEC exports before and after quotas are removed, using outcomes in OTC-UEC as a control. Comparison of MFA-UEC with OTC-UEC assumes that the textile and clothing products in the two groups are subject to similar demand and supply shocks. Some of our results also exploit variation in the extent to which quotas are binding. Following USITC (2002), we define a quota as “binding” if its “fill rate” – exports divided by the respective quota – exceeds some threshold. Using data on the level of U.S., EU and Canadian quotas available from websites maintained by each country, we find that 32 percent of the 1,017 MFA-UEC product-country observations in our data in 2004 have fill rates exceeding 95 percent.<sup>16</sup>

## 4.2 Export Growth Following Quota Removal

Chinese export growth in 2005 is disproportionately large for textile and clothing goods released from quotas, and generally occurs at the expense of state-owned enterprises.

As indicated in the top panel of Table 1, the MFA-UEC group’s 307 percent increase in export value between 2000 and 2005 is the largest among all six groups over this period. By comparison, export growth is 205 percent for OTC-UEC, and 236 percent for Chinese exports as a whole. MFA-UEC’s differentially large growth is due primarily to the 119 percent jump in export value that occurs in 2005, the year that quotas are removed. It’s growth in prior years, by contrast, averages just 17 percent.<sup>17</sup>

Data in the lower panel of Table 1 indicates that the surge in MFA-UEC export value in 2005 is accompanied by a 96 percent increase in the number of MFA-UEC exporters. Here, too, this jump is large relative to prior years as well as the 39 percent increases in OTC-UEC exporters over the same period. This relative growth in the number of exporters provides the first indication of the potential importance of the extensive margin in MFA-UEC’s response to quota removal.

Export growth following quota removal is uneven across firm ownership types. Figure 2 plots the share of export value accounted for by SOEs in MFA-UEC versus OTC-UEC from 2000 to 2005. As indicated in the figure SOE’s share of both markets is declining over time, but the 16 percent decline in MFA-UEC between 2004 and 2005 is particularly sharp with respect to both prior years and OTC-UEC.

Together, Table 1 and Figure 2 highlight three facts about MFA-UEC exports following quota removal. First, MFA-UEC export growth in the year quotas are removed is large relative to previous years and its closest comparator, OTC-UEC. Second, MFA-UEC growth in export value is accompanied by a similarly large increase in the relative number of MFA-UEC exporters. Third, the disproportionately high market share held by SOEs in MFA-UEC under quotas disappears relatively quickly once quotas

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Affairs office. This concordance identifies the set of products subject to quotas in each destination market in 2004.

<sup>15</sup>A particular *firm* may appear in more than one group if it exports multiple goods or to multiple countries. We find that less than 2 percent of MFA-UEC exporters representing an even smaller fraction of MFA-UEC export value are active only in that group. Indeed, depending on the year, 85 to 90 percent of MFA-UEC exporters also export in MFA-ROW. Overlap with other groups, e.g., OTC-UEC is lower, on the order of 80 percent. In our model, we treat multiple-product firms as single-product firms that manufacture different varieties.

<sup>16</sup>Data on U.S., EU and Canadian fill rates are obtained from OTEXA, Système Intégré de Gestion de Licenses, and Foreign Affairs and International Trade Canada, respectively.

<sup>17</sup>U.S., EU and Canadian quotas on China’s MFA export quantities grew an average of 2 to 3 percent per year once China was admitted to the WTO in December 2001 (Brambilla et al. 2009). The relatively high value growth displayed before 2004 in Table 1 reflects a combination of this growth in quantity as well as sizable increases in prices.

are removed. The first fact indicates that the quotas imposed on Chinese exports by the United States, EU and Canada were binding. (Indeed, in unreported results, we find even greater growth in exports and exporters among product-country pairs whose fill rates exceed 95 percent.) The second and third facts suggest that export growth following quota removal is at odds with the efficient-licensing model discussed above, which has export growth following quota removal being concentrated among large and productive incumbents.

### 4.3 Margins of Adjustment

We find that export growth after quota removal is due disproportionately to the extensive margin, and favors privately owned entrants at the expense of incumbent SOEs.

Export growth can be decomposed into one intensive and two extensive margins. The intensive margin is populated by “incumbents” by which we mean eight-digit HS products exported by the same firm to the same country in both 2004 and 2005. The extensive margin is comprised of “entrants” and “exiters”. Entrants are firm-product-country triplets which appear in 2005 but which were not present in 2004. Exiters exhibit the opposite pattern.<sup>18</sup> As illustrated in the top panel of Figure 3, 73 percent of the 10.7 billion dollar growth in MFA-UEC export *value* between 2004 and 2005 is due to net entry. This contribution is large compared to the 49 percent extensive-margin share observed in the smaller increase in OTC-UEC export value over the same period.

The relative contributions of the intensive and extensive margins with respect to growth in export *quantity* are similar, but due to the fact that HS codes vary in terms of the units used to record quantity we cannot report quantity growth for the MFA-UEC and OTC-UEC groups as a whole. Instead, we first compute and decompose quantity growth for each product-country pair in MFA-UEC, and then, in the bottom panel of Figure 3, report the mean growth and mean contribution of each margin across product-country pairs, excluding outliers.<sup>19</sup> As indicated in the figure, on average 86 percent of MFA-UEC quantity growth between 2004 and 2005 is driven by the extensive margin, versus an average of 52 percent for OTC-UEC. This relative contribution of the extensive margin of 34 percent is a key determinant of the degree of inefficiency in the quota allocation, and one that we make use of in the counterfactual analysis in Section 6.

SOEs are the largest incumbent exporters. In 2004, MFA-UEC export value per firm for SOEs and privately owned domestic and foreign firms averaged 2.1, 0.5 and 0.7 million dollars, respectively. Under the null hypothesis of efficient allocation, export growth following quota removal should be concentrated among the largest incumbents due to their greater productivity. Instead, we find in the data that SOEs exhibit the sharpest relative declines in market share during quota liberalization. Figure 4 plots the lowess-smoothed relationship between incumbent firms’ market share in 2004 and the change in this market share between 2004 and 2005. Separate relationships are shown for each ownership type. We find that the largest firms experience the greatest declines in market share across ownership types in both MFA-UEC and OTC-UEC, which likely reflects mean reversion. However, the decline is more pronounced for MFA-UEC, and for SOEs within that group.

A formal decomposition of 2004 to 2005 market share reallocation by margin of adjustment is presented in Table 3. It is constructed by determining the market share of each margin ( $m$ ) within each product-country pair in each year,  $QSHARE_{mhct} = \left( q_{mhct} / \sum_m q_{mhct} \right)$ , taking the difference between years and then averaging these differences across the product-country pairs. Differences are in bold if they are statistically significant at conventional levels.

The first column summarizes the overall shift in market share from incumbents to net entrants, where the latter now distinguishes between “new exporters” and “adders”. New exporters are firms that did not export at all in 2004, while “adders” are firms that exported one or more other (potentially

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<sup>18</sup>Note that multiple-product exporters may be counted in more than one margin of adjustment, e.g., they may exit one product-country and enter another.

<sup>19</sup>We exclude observations outside the 5<sup>th</sup> and 95<sup>th</sup> percentiles. The share of growth due to the extensive margin is 87 percent if these observations are included.

MFA-UEC) products in 2004 prior to adding an MFA-UEC product.<sup>20</sup> MFA-UEC incumbents' market shares decline an average of 21 percentage points across product-destination pairs in the year quotas are removed. This decline is (necessarily) offset by a 21 percentage point average gain by net entrants, for an overall average change of zero. Of this 21 percentage point gain, adders and new exporters contribute 65 and 6 percent, respectively, while exiters account for -50 percent.

Columns two through four of Table 3 decompose the overall change for each margin by type of firm ownership; in each row, the sum of the final three columns equals the value in the first column. Three trends stand out. First, there is a *net* reallocation of activity away from SOEs, with their 22 percent decline in market share being offset by 13 and 8 percentage-point gains on the part of privately owned domestic and foreign firms, respectively.<sup>21</sup> Second, there is substantial *gross* reallocation of market share within firm types. This gross reallocation is highest among SOEs, where exiters and adders contribute -32 and 26 percent points, respectively, and the overall negative contribution of net entry reinforces the loss of market share by incumbents. Among privately owned domestic and foreign firms, by contrast, net entry makes a positive contribution that more than offsets incumbents' loss. Third, while net entry by new exporters is negligible among SOEs, it accounts for 5 and 1 percentage points of the overall 13 and 8 percentage point gains of privately owned domestic and foreign firm.

The "single" differences reported in the left panel of Table 3 do not reveal the extent to which 2004 to 2005 changes in MFA-UEC margins' market shares deviate either from changes in OTC-UEC over the same period, or from these groups' changes in the prior period. Examination of such "triple" differences aids our assessment of whether single differences are related to quota removal versus other factors common to textile and clothing products over time, such as the removal of entry barriers and the declining importance of SOEs.

We estimate triple differences using the following product-country level OLS regression:

$$\Delta QSHARE_{mhct} = \alpha_0 + \alpha_1 1t = 2005 + \alpha_2 1\{hc \in \text{MFA-UEC}\} + \alpha_3 1\{t=2005\} \times 1\{hc \in \text{MFA-UEC}\} + e_{mhct}. \quad (11)$$

In 11,  $1\{t=2005\}$  and  $1\{hc \in \text{MFA-UEC}\}$  are indicators for 2005 and the presence of a product-country pair in group MFA-UEC, respectively. Complete regression results are reported in Appendix Table 8. As indicated in the Appendix, the sum of all four coefficients equals the first difference reported in the left panel of Table 3, while sum of  $\alpha_2$  and  $\alpha_3$  is the relative change in MFA-UEC vs OTC-UEC between 2004 to 2005. The coefficient  $\alpha_3$  represents the "triple" difference, i.e., the difference in MFA-UEC versus OTC-UEC between 2004 to 2005 relative to their 2003 to 2004 changes.

The right panel of Table 3 reports  $\alpha_3$  by margin and ownership type. Comparison of the left and right panels reveals that 2004 to 2005 market share changes in MFA-UEC remain substantial even after netting out prior trends and the behavior of OTC-UEC. The overall transfer of market share from incumbents to net entrants is 17 percent in Table 4 versus 21 percent in Table 3. Likewise, the gains of privately owned entrants at the expense of SOE incumbents is preserved. In unreported results (available upon request), we find even stronger reallocation from SOE incumbents to privately owned entrants among product-country pairs where quotas are binding, i.e., where fill rates exceed 95

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<sup>20</sup>As noted in Table 1, there are 18,628 MFA-UEC exporters in 2005. A given firm may contribute to both the intensive and "adder" extensive margins if they both continue exporting at least one MFA-UEC product between 2004 and 2005 and add another MFA-UEC product during that interval. We find that 4,668 firms satisfy these criteria in 2005; they account for 74 percent of 2005 MFA-UEC export value and experience a near doubling of their average number of MFA-UEC products, from 9.8 in 2004 to 17.3 in 2005. We find that an additional 1,132 firms are "pure incumbents", i.e., they continue exporting at least one MFA-UEC product between 2004 and 2005 but do not add any new MFA-UEC products after quotas are removed. These pure incumbents account for less than 3 percent of 2005 MFA-UEC export value and exhibit a decline in their average number of MFA-UEC products from 2.2 in 2004 to 1.3 in 2005. A relatively large number of firms – 12,828 – add at least one MFA-UEC product between 2004 and 2005 without having exported in this group (or at all) in the year before. These firms represent 23 percent of 2005 MFA-UEC export value and pick up an average of 4 MFA-UEC products.

<sup>21</sup>Price changes explain the difference between the 21 percent decline in SOEs average quantity-based market shares in Table 3 and their 16 percent decline in value-based market share in Table 2.

percent.<sup>22</sup> These results are virtually identical with the inclusion product-country fixed effects, which control for trends in prices within product-country pairs.

Together, the results in Figure 4 and Table 3 provide further evidence against efficient allocation of quotas prior to the end of the MFA. Before continuing, we note that our measurement of the extensive margin in this section is potentially sensitive to unobserved sub-contracting of quota-holders' allocation to firms whose names do not appear on customs documents. We address this concern in detail in Section 5.1.

#### 4.4 Prices

MFA-UEC export prices fall relative to the export prices of all other groups the year that quotas are removed. In contrast with the efficient allocation model developed above, however, these declines are due disproportionately to net entrants rather than incumbents.

Figure 5 displays the mean percent change in groups' export prices between 2004 and 2005. These changes are computed in two steps. First, for each product-country ( $hc$ ) pair in each year ( $t$ ), we calculate a weighted-average export price ( $\bar{P}_{hct}$ ) across all exporting firms' export unit values ( $p_{fhct}$ ) using their quantity market shares ( $\theta_{fhct}$ ) as weights,

$$\bar{P}_{hct} = \sum_f \theta_{fhct} p_{fhct}. \quad (12)$$

Then, for each product-country pair, we compute the percent change between years  $t$  and  $t - 1$ ,  $\Delta \bar{P}_{hct} = (\bar{P}_{hct} - \bar{P}_{hct-1}) / \bar{P}_{hct-1}$ . Each bar in Figure 5 displays the mean of  $\Delta \bar{P}_{hct}$  across all product-country pairs in MFA-UEC and OTC-UEC for 2004 and 2005, excluding outliers.<sup>23</sup> As indicated in the figure, export prices in MFA-UEC fell 8.1 percent on average between 2004 and 2005. In OTC-UEC, by contrast, average export prices grew 13.5 percent. Thus, relative to its closest comparator group, MFA-UEC export prices fell 21.7 percent. The MFA-UEC price decline in 2005 is also sharp relative to the group's average price *growth* of 16.0 percent between 2003 and 2004.

Figure 6 compares the export prices of entrants to exiters to incumbents. To facilitate comparison across products using different quantity units, we normalize incumbent and entering firm's export prices in 2005 by their across-year, product-country mean ( $p_{fhc2005} / \bar{P}_{hc}$ ), where

$$\bar{P}_{hc} = \frac{1}{2} (\bar{P}_{hc2004} + \bar{P}_{hc2005}). \quad (13)$$

For exiters, where a 2005 price is not observed, we divide firm's 2004 export prices by the same mean,  $p_{fhc2004} / \bar{P}_{hc}$ . As in Figure 5, we exclude firms whose relative prices are below and above the first and ninety-ninth percentiles of each distribution, respectively.

A key feature of Figure 6 is that the price distribution for exiters lies to the right of that for entrants. This ordering indicates that firms exiting MFA-UEC in 2004 have relatively high prices compared to firms entering the group in 2005. By comparison, Figure 7 reveals that we do not find a similar ordering of entrants' and exiters' prices either contemporaneously in OTC-UEC or in MFA-UEC the year before. Indeed, exiters' prices are *lower* than entrants' prices in MFA-UEC in 2004 and are almost indistinguishable from entrants' prices in OTC-UEC in 2005. This is consistent with our analysis that quotas were allocated to relatively inefficient, high price firms who were replaced with more productive entrants when the quotas were removed. A second notable feature of Figure 6 is that MFA-UEC incumbents' export prices in 2005 have a thin left tail compared to entrants, i.e.,

<sup>22</sup>These results are generated by adding an interaction between indicators for bindingness and 2005 to the regression specification in (11)

<sup>23</sup>Extreme price changes are found for some product-country combinations, e.g., HS 62101030, "garments of felt or nonwovens, of man-made fibers", to Suriname, which grew 70,000 percent between 2004 to 2005. In Figure 6 we drop product-country pairs whose price changes are either below or above the first and ninety-ninth percentile, respectively. Though excluding these product-country pairs lowers average export price growth in all groups, it does not undermine any of the substantive patterns discussed in this section.

they have a lower proportion of very low prices. To the extent that incumbents' relatively high prices do not reflect variation in quality (more on this below and in Section 5.3), they provide intuition for the loss of market share by incumbents discussed in the last section. Indeed, incumbents' ability to retain as much market share as they did given their relatively high prices may be due market or policy asymmetries such as long-term contracts or better marketing information that give high-priced incumbents an advantage over low-priced entrants.

We quantify the relative importance of each margin in the overall growth of MFA-UEC prices using a productivity decomposition proposed by Foster et al. (2008) and Griliches and Regev (1995). Here we decompose prices rather than productivity:

$$\begin{aligned} \Delta \bar{P}_{hct} = & \frac{1}{\bar{P}_{hct-1}} \left[ \sum_{f \in I} \bar{\theta}_{fhc} (p_{fhct} - p_{fcht-1}) + \sum_{f \in I} (\theta_{fhct} - \theta_{fhct-1}) (\bar{p}_{fhc} - \bar{P}_{hc}) \right] \\ & + \frac{1}{\bar{P}_{hct-1}} \left[ \sum_{f \in N} \theta_{fhct} (p_{fhct} - \bar{P}_{hc}) \right] - \frac{1}{\bar{P}_{hct-1}} \left[ \sum_{f \in X} \theta_{fhct-1} (p_{fhct-1} - \bar{P}_{hc}) \right]. \end{aligned} \quad (14)$$

As above,  $\theta$  represents quantity-based market share and  $f$ ,  $h$  and  $c$  index exporters, eight-digit HS categories and countries, respectively.  $I$ ,  $N$  and  $X$  correspond to the sets of incumbent, entering (new exporters plus adders) and exiting firms, respectively. (We do not break entrants into adders versus new exporters given the relatively small market share of new entrants noted in Table 3.)  $\bar{\theta}_{fhc}$  is the average market share of firm  $f$  in  $hc$  across 2004 and 2005, i.e.,  $\bar{\theta}_{fhc} = (\bar{\theta}_{fhct} + \bar{\theta}_{fhct-1})/2$ . Finally,  $\bar{p}_{fhc}$  is the average price of firm  $f$  in product-country  $hc$  across years  $t$  and  $t-1$ . Like  $\bar{\theta}_{fhc}$ , it can be computed only for incumbents.

The first term in square brackets captures the intensive margin. Its “within” component, the first term inside the brackets, measures the price change of incumbent exporters holding their market share fixed. The second, “across” component accounts for changes in incumbents market shares, weighting those changes by the difference between the firm’s average across-year price and the overall average across-year price ( $\bar{p}_{fhc} - \bar{P}_{hc}$ ). If incumbents’ prices fall (due, for example, to the elimination of the license fee), the within component is negative. If incumbents’ prices are relatively high and their market shares tend to decline, the across component is also negative and both components contribute to a reduction in  $\Delta \bar{P}_{hct}$ . The second term captures the entry margin; this term is negative if entrants’ prices are lower than the across-year average price. The third term captures the exit margin, and its interpretation is analogous to the entry term: it is positive if exiters have relatively high prices compared to the across-year average. Note that because this term is *subtracted* from the previous two, positive values make a negative contribution to the overall price change.

We use regressions analogous to equation (11) to examine relative changes in MFA-UEC export unit values across across product-country pairs by margin of adjustment and type of ownership. (The “single” and “triple” differences implied by these regressions are reported in Appendix Table 9). Here, they are summarized in the left and right panels of Table 4 using the same format as Table 3. In this case, triple differencing helps control for inflation (our value data are nominal) as well as other factors such as changes in technology and exchange rate movements that affect the prices of all Chinese textile and clothing exports equally. Each column of each table sums to the penultimate row, while each row except for the last sums to the first column. The final row summarizes the contribution of the extensive margin. These results drop the same product-country outliers as Figure 6; statistically significant coefficients are in bold.

As indicated in left panel of Table 4, the 8.1 percent average decline in MFA-UEC export between 2004 and 2005 displayed in Figure 5 is due primarily to the extensive margin, with the net entry margin accounting for 59 percent of the overall decline  $((-0.045-0.003)/-0.081)$ . This relative importance of the extensive margin is inconsistent with our model of efficient allocation. Examination of the within and across terms for the incumbent margin indicate that changes in price as well as changes in market

share back its affect. The negative within term reveals that MFA-UEC incumbents experienced price declines, while the negative across term indicates that incumbents with relatively high prices tended to lose market share. The remaining columns of the left panel of Table 4 highlight the influence of SOEs on price trends. Roughly half (-0.038/-0.081) of the overall 2004 to 2005 decline in MFA-UEC prices is due to SOEs. In contrast with privately owned firms, the majority of the SOE price decline (68 percent) is accounted for by the intensive margin. For privately owned domestic and foreign firms, the intensive margin shares are just 21 and 5 percent, respectively.

The triple-difference price changes reported in the right panel of Table 4, while broadly similar to the single-difference changes, nevertheless exhibit three important differences. First, the overall price decline of 16.9 percent is more than twice as steep as the 8.1 percent decline in the left panel, which is understandable given the price increases in 2003 to 2004 and in OTC-UEC displayed in Figure 5. Second, a greater share of the triple-difference decline – 54 percent (-0.092/-0.169) – is due to SOEs, and a larger share of that decline is due to SOE’s extensive margin. Finally, the price declines associated with the exit of relatively high-priced firms is substantially higher, and statistically significant. This trend indicates that the high-priced exiters of MFA-UEC between 2004 and 2005 were particularly high priced compared to OTC-UEC exiters and MFA-UEC exiters between 2003 and 2004.<sup>24</sup>

These patterns of price responses are inconsistent with the efficient allocation model, where price declines should be driven by incumbents (and entrants should contribute to higher prices because of their relatively lower efficiency). If prices reflect quality, an alternative interpretation of the relative price declines documented in this section is quality downgrading. Because quotas exert a relatively high penalty on low-price (low-quality) goods, firms may have an incentive to raise export quality when quotas are imposed and reduce export quality when they are removed. Under this interpretation, the net entry of relatively low-price exporters merely reflects the net entry of relatively low-quality producers. However, if firm productivity and quality are positively related, this view of the evidence is inconsistent with the net entry of relatively more-productive privately owned firms which we documented in Section 4.3 and discuss further in the next subsection.<sup>25</sup> The entry of relatively more productive firms implies that any evidence of quality downgrading does not affect the overall message that the quota licenses were allocated to inefficient firms. Nevertheless, we provide evidence in Section 5.3 that the MFA-UEC entrants in 2005 did not have relatively lower quality using explicit estimates of export quality from price and quantity information.

## 4.5 Productivity

Our model of efficient allocation predicts that entering firms are less productive than incumbents. Unfortunately, we are unable to estimate the productivity of entrants directly due to difficulties associated with matching trade and production data.<sup>26</sup> We do, however, observe a key firm characteristic – ownership type – that can be used to make indirect inferences about productivity.

Existing estimates of Chinese firm’s productivity indicate that state-owned enterprises are substantially less efficient than privately owned domestic or foreign firms. Using the Annual Survey of

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<sup>24</sup>In unreported results (available upon request), we find greater price declines among eight-digit HS products whose quotas were binding in 2004. In particular, we find entrants prices to be relatively lower, and exiters prices to be relatively higher, compared to results for products whose fill rates are less than 95 percent. We also find virtually identical triple-difference results after including product-country fixed effects, which control for trends in prices and identifies changes within these groups between 2003-4 and 2004-5.

<sup>25</sup>It is of course possible that high-productivity entrants choose to export low-price, low-quality goods in 2005. This choice hinges on the relative costs and benefits of quality upgrading (see, for example, Baldwin and Harrigan 2009, Kugler and Verhoogen 2010 or Johnson 2009). In fact, empirical evidence in Khandelwal (2010) or Kugler and Verhoogen (2010), suggest that the clothing may be an example of such an industry where, on average, the pursuit of high quality by high productivity firms is unlikely.

<sup>26</sup>In principle one might merge the trade data, which identifies entrants versus incumbents at the HS-country level, with China’s Annual Survey of Industrial Production, which provides information on output and inputs. In practice, match rates from this merge are quite low given the difficulties of matching firms based on their names rather than numerical identifiers. Of the 37,986 firms that we observe in the trade data exporting textile and clothing products in 2004, we have succeeded in matching 7,157 firms (19 percent) to the Annual Survey.

Industrial Production (ASP), which provides information on output and inputs for all SOEs and non-SOEs with revenue greater than 5 million RMB. Brandt and Zhu (2010) estimate the aggregate total factor productivity (TFP) of SOEs to be half the level of non-SOEs. Hsieh and Klenow (2009) use the same data to estimate TFP at the firm level and find that, on average, SOEs' productivity is 41 percent that of domestic private firms.

Neither of these studies report differences between exporting and non-exporting firms. Here, we use the ASP to compare the TFP of state and non-state exporters. We restrict our comparison to exporters whose major line of business in 2005 is textiles or clothing (industry codes 17 or 18), though we caution that this will exclude many exporters of these goods whose main line of business lies outside this industry. Of the 15,214 textile and clothing exporters found in the ASP, 142 are SOEs, 7,992 are privately owned domestic firms and 7,080 are privately owned foreign firms. Following Brandt, Van Biesebroeck and Zhang (2009), we estimate TFP using a Tornqvist index number approach,

$$\ln(TFP_f) = (va_f - \bar{va}) - \tilde{s}_f(l_f - \bar{l}) - (1 - \tilde{s}_f)(k_f - \bar{k}), \quad (15)$$

where  $va$ ,  $l$ , and  $k$  are in logs and denote value added, wages and fixed assets (net of depreciation) for each firm, and where a bar over a variable denote an average across all textile and clothing exporters. The weight on wages is  $\tilde{s}_f = (s_f + \bar{s})/2$ , where  $s_f$  is the share of wages in total value added by each firm and  $\bar{s}$  is the average across firms. The TFP measure for a given firm is relative to a hypothetical firm with the average output and inputs. Following Brandt et al. (2009), wages are defined as reported firm wages plus employee benefits (unemployment insurance, housing subsidies, pension and medical insurance), and the capital is reported capital stock at original purchase price less accumulated depreciation.

Figure 8 plots the distribution of textile and clothing exporter's TFP relative to the hypothetical average firm by type of ownership. As indicated in the figure, while some SOEs exhibit relatively high productivity, their distribution lies substantially further to the right than the distributions of privately owned exporters. On average, SOEs are 18 percent less productive than the hypothetical mean, while privately owned domestic and foreign exporters are 76 and 54 percent more productive, indicating that the average privately owned domestic and foreign firms are 88 and 72 percent more productive than SOEs.

In Table 5, we combine these estimates with the market share changes by ownership type reported in Table 2 to provide a coarse, back-of-envelope estimate of the productivity gain associated with the replacement of SOEs by privately owned firms. The first column of the table reports each type of firm's average TFP relative to the hypothetical mean. The second column reports the change in market share for each firm type in MFA-UEC between 2004 and 2005. Assuming that all firms within an ownership type have the same relative TFP, and that firms' TFP remains constant as the MFA ends (both of which are conservative), the growth in aggregate MFA-UEC TFP following quota removal is 18.5 percent (column 3). This increase is substantial relative to the 9.7 percent growth implied by the corresponding market share changes in OTC-UEC over the same period reported in columns 4 and 5. These numbers imply that the removal of quotas increased TFP among China's textile and apparel exporters by 8.8 percent. This is large relative to the average 4 percent TFP growth of all non-agricultural firms in China over the 1998 to 2007 period found in the growth accounting exercise conducted by Brandt and Zhu (2010).

In Section 6, we discuss how such an overall gain in TFP might be decomposed into the part due to the removal of quotas versus the part due to the dismantling of the inefficient quota allocation institution.



## 5 Caveats and Alternate Explanations

### 5.1 Subcontracting by Producing Firms

Our estimates are sensitive to unobserved subcontracting. More precisely, if the quota-holding firm and the ultimate producer of the export are different, and if customs documents list the name of the former rather than the latter, then our estimates of extensive-margin activity following quota removal will be biased upwards if subcontractors officially replace quota holders on trade documents starting in 2005. Furthermore, assignment of subcontracts on the basis of efficiency (for example, via a black-market auction) would complicate our ability to identify a reallocation of exports towards more efficient firms when the MFA ended.

In principle, subcontracting's influence on our results should be minimal given its illegality. Unfortunately, as noted in Section 3, we have been unable to determine via interviews or secondary sources the extent to which it might have occurred. Nevertheless, five trends in the data suggest that subcontracting exerts a limited effect on our results.

First, if quota holders were subcontracting to efficient non-quota holders, one might expect these subcontractors to be dominated by a relatively small number of large (i.e., efficient) producers, and that these producers would dominate entry once quotas are removed. Instead, as noted in footnote 20 in Section 4.3, we find that *new* MFA-UEC entrants in 2005 are relatively numerous and relatively small.

Second, if subcontracting were the only way a firm with a quota could fulfill it, the firms relying on subcontractors in 2004 would exit or shrink substantially once quotas were removed. In fact, we find that few incumbents' exports actually decline from 2004 to 2005, and that MFA-UEC exit rates are relatively low compared with OTC-UEC exit rates across all ownership types (Table 3).<sup>27</sup>

Third, we find that 86 percent of MFA-UEC exporters in 2004 are also active in MFA-ROW. Given that these firms are present in MFA-ROW, they likely have the ability to produce for MFA-UEC as well. (Subcontracting MFA-ROW exports makes little sense given that it is not quota constrained). It is therefore not obvious why a quota-holder would subcontract production of MFA-UEC but produce its own output for exports to MFA-ROW.<sup>28</sup>

Fourth, we find little evidence in the Annual Survey of Producers that T&C producers' exports exceeded their production, as might be expected if they were on-exporting subcontractors' output. In both 2004 and 2005, the production-to-export ratio is greater than one for 95 percent of firms that report textile and apparel as their main line of business. One caveat here is that information revealed by the production-to-exports ratio depends on the relative importance of the export market; firms selling large quantities domestically might nevertheless export a relatively small amount of sub-contracted production.

Finally, we find a relatively strong contribution by the extensive margin in "processing" versus "ordinary" exports, where the former refers to exports that are assembled in an export processing zone with a disproportionate share of raw materials that are imported at reduced or often zero tariff rates. Subcontracting of processed exports is more difficult, especially for subcontractors that lie outside the processing zone, given that the rules governing this class of exports must be obeyed by the subcontractor.<sup>29</sup> Table 6 compares the relative contribution of the extensive margin in MFA-UEC versus OTC-UEC exports for processed versus all exports. We find that MFA-UEC incumbents lose *more* relative market share in processing exports (-21.7 percent) than in all exports (-16.7 percent), and a similar reallocation away from SOEs.

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<sup>27</sup>While it is true that SOEs' market shares decline substantially, this reallocation is driven by faster growth among privately owned firms than SOEs, i.e., almost all incumbents experienced growth in export quantity between 2004 and 2005.

<sup>28</sup>As discussed in Section 3, virtually all MFA products had full trading rights so all firms could directly export an MFA product to ROW if they so chose.

<sup>29</sup>We identify processed exports via a flag in the customs data. Processed exports account for 19 and 20 percent of MFA-UEC exports in 2004 and 2005, respectively.

## 5.2 Subcontracting by Intermediaries

Unobserved subcontracting by intermediaries (i.e., non-producing “trading” firms) presents a different challenge to identification than subcontracting by producers: while the latter had no reason to continue once the quota institution ended, there is no reason for the former to disappear. Furthermore, even if the number of intermediaries remained constant between 2004 and 2005, the number of producing firms with which they contracted – and, therefore, their influence on the “true” adjustment of China’s extensive and intensive margins – would be unknown because we do not observe the set of producers from which an intermediary sources.

One might expect trading firms to be replaced by producers in 2005 if quota-rich trading firms were an important conduit for quota-poor producers’ goods. In fact, we find relatively strong entry by “trading firms”, defined as in Ahn et al. (forthcoming) as firms with the words “importer”, “exporter” or “trader” in their title, in MFA-UEC versus OTC-UEC between 2004 and 2005. One reason for this growth that is consistent with our conclusions above but which contributes to an *under-estimation* of the influence of the extensive margin, is that intermediaries helped a new set of low-productivity entrants overcome the fixed costs of exporting once quotas were removed (Ahn et. al, forthcoming). One caveat associated with this conclusion is that our classification of firms as trading companies is imperfect, and, in particular, might result in firms that have both production and trading arms being classified as traders. A large fraction of the textile and clothing apparel SOEs that export, for example, are classified as traders, which is at odds with the evidence presented above that virtually all SOEs in the ASP have higher production output than exports. Indeed, according to our classification, trading companies account for 48 and 46 percent of OTC-UEC and MFA-UEC exports in 2004, which is quite large relative to the 24 percent share of intermediaries in China’s overall exports. If we reclassify all SOEs as producers, the export share of the remaining firms classified as traders falls to 13 and 11 percent, respectively.

## 5.3 Quality Downgrading

An alternative interpretation of the price declines observed in Section 4.4 is that following the removal of the quotas, firms lowered product quality. We investigate quality downgrading by embedding consumer’s preference for quality ( $\lambda$ ) in the CES utility employed in our model of efficient allocation:

$U = \left( \int_{\omega \in \Omega} (\lambda(\omega)q(\omega))^{(\sigma-1)/\sigma} d\omega \right)^{\sigma/(\sigma-1)}$ . The demand for a particular firm  $f$ ’s export of product  $h$  to destination country  $d$  at time  $t$  is given by:

$$q_{fhd} = \lambda_{fhd}^{\sigma-1} p_{fhd}^{-\sigma} P_{dt}^{\sigma-1} Y_{dt} \quad (16)$$

Taking logs of equation (16) and using the elasticity of substitution  $\sigma = 4$  described above, we employ data on quantity and unit value to estimate via OLS the relative quality of each exported variety:

$$\ln q_{fhd} - \sigma \ln p_{fhd} = \alpha_h + \alpha_{dt} + \epsilon_{fdht}, \quad (17)$$

where  $\hat{\epsilon}_{fdht}$  is the residual from the estimated regression and  $\lambda_{fhd} \equiv e^{\hat{\epsilon}_{fdht}/(\sigma-1)}$ . The intuition behind this approach is similar to Hummels and Klenow (2005), Khandelwal (2010) and Hallak and Schott (2011): conditional on price, a variety with a higher quantity is assigned higher quality. By imposing the same elasticity of substitution across textile and clothing products, we avoid having to estimate demand before inferring quality. Here,  $\alpha_{dt}$  collects the destination price index ( $P_{dt}$ ) and income ( $Y_{dt}$ ), and  $\alpha_h$  is included because prices and quantities are not necessarily comparable across product categories.

Table 7 reports a breakdown of average absolute and relative MFA-UEC quality change by margin of adjustment and ownership type. This breakdown is analogous to the ones provided for market share and prices in Tables 3 and 4. Single-difference results in the left panel indicate an overall increase in average quality of 25 percent between 2004 and 2005. The triple-difference outcomes

in the left panel, however, demonstrate that this *absolute* increase in MFA-UEC was small relative to OTC-UEC. Indeed, the triple differences reveal that *relative* MFA-UEC quality falls an average of 10.9 percent between 2004 and 2005.<sup>30</sup> Unlike the price and market share results, however, we find in unreported results (available upon request) that this overall quality decline is not statistically significant if country-product pair fixed effects are included.

Comparison of the left hand panels of Tables 7 and 4 reveals that quality downgrading cannot fully explain observed price trends, especially among entrants. First, we find that overall, prices decline further than quality (-16.9 versus -10.9 percent). Second, we find that this mismatch is particularly evident along the extensive margin: while net entrants account for 63 percent of the overall decline in prices (-0.105/-0.169), their quality downgrading is small part of the overall decrease in quality (-0.034/-0.109) and also statistically insignificant at conventional levels. For quality, by contrast, the overall decline is driven by incumbents, whose market shares fall substantially more than their prices (-0.167 in Table 3 versus -0.029 in Table 4). Based on this evidence, we conclude that the low prices of entrants implied high productivity rather than low quality.

## 6 Decomposing Productivity Gains

Given the evidence against efficient allocation presented in Section 4, we construct a model of “inefficient allocation” to decompose the overall productivity gain following the end of the MFA into the part that is due to the removal of the quotas versus the part that is accounted for by the removal of the export licensing institution that managed it. This model relies on the same basic structure, assumptions and parameters as the efficient-allocation model, including asymmetric iceberg transportation costs and Pareto-distributed firm productivity, that we used in Section 2.2.

We first solve the model under the scenario that firms do not face quotas in the foreign market. In this “quota-free equilibrium”, we find that aggregate TFP among China’s exporters is 10.5.

We next solve the model under efficient quota allocation. We first need to determine the restrictiveness of the quota. The median country-product export quantity growth for MFA-UEC between 2004 and 2005 was 162 percent versus 25 percent in OTC-UEC. Thus, relative to OTC-UEC, MFA-UEC exports grew 137 percent. This translates into a quota restrictiveness of 58 percent ( $1-1/2.37$ ).<sup>31</sup> As described in Section 2.2, firms choose whether or not to pay the common license fee implied by this restrictiveness. While the most productive firms do pay the fee and enter the export market, the fee keeps their market shares relatively low compared to the quota-free equilibrium, constraining aggregate TFP to 5.6. As illustrated in the right panel of Figure 9, this result implies aggregate TFP growth of 4.9, or 87 percent ( $4.9/5.6$ ), in moving between an equilibrium in which quotas are allocated efficiently to one which is quota-free. This large gain is driven by the highly skewed distribution of exporter productivity: as quotas are removed, exports by the highest-productivity incumbents surge. As noted in Irarrazabal et al. (2010), the large gains associated with the removal of specific tariffs, or, in our case, licensing fees, exceed those implied by traditional trade models that solely consider the removal of iceberg transportation costs (i.e., the class of trade models discussed in Arkolakis et al., 2010).

To solve the model under inefficient allocation, we impose the same quota restrictiveness as under

<sup>30</sup>This within-product method for inferring quality downgrading used here differs from the across-product approach adopted by Harrigan and Barrows (2009). In the latter (also used by Aw and Roberts 1986 and Boorstein and Feenstra 1991), quality downgrading is defined as a shift in consumption from high- to low-priced HS categories over time, as identified by a relative decrease in a quantity-weighted versus value-weighted average price index. We follow our approach to identify quality changes in MFA-UEC versus OTC-UEC for two reasons. First, across-product evidence of quality downgrading does not account for quality changes within HS categories or within firms, which our data can address directly. Second, lower prices may also reflect increases in a firm’s efficiency, which must be disentangled from quality.

<sup>31</sup>Observed export growth in 2005 is due both to the removal of the quotas and to the elimination of their embedded institutions. In using this overall observed export growth to solve the model under efficient allocation, we therefore likely *overstate* export growth due solely to the removal of the quotas. Over-statement of export growth implies our *under-estimation* of TFP under efficiently allocated quotas and, therefore, *under-estimation* of the contribution of the removal of the embedded licensing institution in the inefficient-allocation equilibrium below. Thus, our estimate of the contribution of the removal of the embedded institution is conservative.

efficient allocation, but assume the government allocates market share to  $N$  exporters based upon “political connections” that are potentially uncorrelated with productivity. Thus, to solve the model, we need to choose a value for  $N$ , draw a political connection for each firm, and then use the draws to allocate quota among the  $N$  firms.

Two pieces of information determine  $N$ . The first is the relative growth of MFA-UEC versus OTC-UEC firms between 2004 and 2005 which, as reported in Table 1, is 57 percent. The second piece of information is the number of exporters under the no-quota equilibrium. This number is generated in the quota-free solution discussed above. We choose  $N$  to be 57 percent of this number; as a result, when we remove inefficiently allocated quotas, the growth in exporting firms in the model will match the data perfectly.

We draw firms’ political connections from a standard uniform distribution in a way that allows for a correlation between political connectedness and productivity.<sup>32</sup> To determine the amount of quota allocated to each of the  $N$  firms, we use the empirical distribution of export values observed in 2004. That is, we divide the actual export transactions in 2004 – all of which by definition were exported under a quota allocation – into 1000 bins and compute the market share of each bin. We then divide the  $N$  firms into 1000 bins, and give each of them the value market share needed to match the total value market share of their respective bin in the empirical distribution. (We use value- rather than quantity-based market because we cannot compare quantities across products).

As reported in Figure 10, we compute TFP and the net contribution of the extensive margin to export growth following quota removal for various levels of correlation between productivity and political connectedness. Each point in the figure represents a different correlation between the two draws. Intuitively, we find that aggregate TFP is lower, and the contribution of the extensive margin is higher, as the correlation between the two draws falls: the stronger the relationship between political connections and productivity, the lower the penalty for inefficient allocation. We seek a correlation that matches the 34 percent growth in the MFA-UEC versus OTC-UEC extensive margin following quota liberalization reported in Figure 3, a key statistic that identifies misallocation of the licenses. As indicated in the figure, extensive-margin growth of 34 percent along the  $x$ -axis corresponds to a TFP of 1.80 along the  $y$ -axis and implies a 24 percent correlation between the two draws.

As illustrated in Figure 9, these results imply that removal of China’s inefficient quota-allocation institution – for a TFP gain of 3.8 – is close to the 4.9 TFP gain associated with the removal of efficiently allocated quotas. That is, of the overall gain associated with the removal of inefficiently allocated quotas, 44 percent is due to the institutional reform embedded in the liberalization.

We note that while the *absolute* gain from quota removal is sensitive to the skewness of the productivity distribution, the relative importance of institutional reform is not. We find that inefficient allocation accounts for 40 to 60 percent of the overall gain as the Pareto shape parameter varies between 5.5 and 3.2 and all other parameters are held fixed. Results are also insensitive to calibration of export size and fraction of exporters to a lognormal distribution (mean 0.4 and standard deviation of 0.8). Under that assumption, the contribution of inefficient licensing is also 44 percent. Finally, we also examine the sensitivity of our numerical solutions to the particular net extensive margin growth we use to calibrate the model. As discussed in Section 4, unobserved subcontracting may under certain circumstances lead us to over-estimate this key statistic. As noted in Figure 10, if the “true” contribution of this margin were 25 rather than 34 percent, aggregate productivity in the inefficient model would be 2.04, implying inefficient allocation accounts for 42 percent of the overall productivity gain from removing the quotas.

The large absolute productivity gains in the model are driven by the skewed productivity distribution we observe in the data. Applying the implied breakdown of gains to the growth implied by the back-of-envelope calculation in Table 5, we find that the removal of the inefficient licensing institution increased textile and clothing exporters’ productivity by 3.9 percentage points ( $8.8 \cdot .44$ ) while removing the quotas increased productivity their productivity by the remaining 4.9 percentage points.

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<sup>32</sup>We can change the correlation between a firm’s productivity ( $\varphi$ ) and its political connection ( $pc$ ) draw by  $pc = \rho\varphi + \sqrt{(1 - \rho^2)}\epsilon$ , where  $\rho$  is the correlation and  $\epsilon$  is an i.i.d. random variable.

## 7 Conclusion

We evaluate productivity gains from a specific trade liberalization episode—the removal of textile quotas on Chinese exporters. Following liberalization, we observe substantial reallocation away from inefficient incumbent firms towards efficient entrants which implies large productivity gains among these textile exporters. These patterns of adjustment are at odds with predictions of a model under which quota licenses were allocated based on firm productivity.

This episode highlights two key themes that have been under-studied in the literature. First, while many studies have emphasized misallocation of resources among the set of active firms, we observe misallocation along the extensive margin. Explicit government policy kept quota licenses out of the hands of the most productive textile exporters and once this institution was dismantled, these firms enter the export market. The removal of the licensing institution highlights the second key implication of our analysis. Theoretical models in international trade typically presume an efficient allocation of resources, irrespective of trade barriers. However, institutions that evolve to manage trade barriers are often corrupted by government bureaucrats which impose additional distortions in addition to the trade barrier itself. Trade liberalization that dismantles such institutions delivers additional gains from trade beyond just the removal of the trade barrier. Our counterfactual analysis suggests that moving from an inefficient quota allocation to an efficient one delivers almost twice the TFP gains than the removal of the trade barrier itself. That is, the efficiency cost of the quota on the Chinese exporters could be reduced by more than half through internal reforms of the licensing system.

Our results provide one explanation for why empirical findings of the gains from trade, for instance in Feyrer (2010) or Pavcnik (2002), are often large compared to the gains predicted in standard models of international trade (e.g., Arkolakis et. al 2010). These models ignore the fact that countries must create institutions to manage the trade barriers they impose, and that these institutions may impose inefficiencies in addition to those directly caused by the trade barrier. The results in this paper suggest that an interesting avenue for future research would be embed institutional reforms within trade models to enhance our understanding of the gains from trade.

## A Additional Empirical Results

Table 8 contains the underlying regression output for the results reported in Table 2. Table 9 contains the underlying regression output for the results reported in Table 4. Table 10 contains the underlying regression output for the results reported in Table 7.

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	Export Value (\$Billion)						Total
	ROW			US/EU/Can			
	NTC	OTC	MFA	NTC	OTC	MFA	
2000	104.8	8.8	27.3	79.5	6.2	4.8	231.4
2001	132.7	8.9	34.3	97.1	6.6	6.2	285.8
2002	153.0	8.9	37.0	112.4	7.9	6.5	325.6
2003	204.7	11.2	46.1	157.3	11.2	7.9	438.5
2004	283.6	13.9	55.8	217.1	14.3	8.9	593.6
2005	383.6	16.6	58.2	279.8	18.8	19.6	776.6
%Growth 2000-5	266	88	113	252	205	307	236
Annual %Growth 2000-4	28	12	20	29	23	17	27
%Growth 2004-5	35	19	4	29	32	119	31

	Number of Firms						Total
	ROW			US/EU/Can			
	NTC	OTC	MFA	NTC	OTC	MFA	
2000	37,500	10,225	11,973	24,044	5,298	3,536	47,413
2001	47,093	11,778	14,878	30,274	6,482	4,253	59,527
2002	61,583	14,447	19,169	39,309	9,652	5,911	78,612
2003	74,926	17,608	23,097	49,049	12,701	7,793	95,688
2004	94,919	22,548	29,216	63,085	16,554	9,523	120,535
2005	112,488	26,287	33,848	77,028	23,001	18,628	143,676
%Growth 2000-5	200	157	183	220	334	427	203
Annual %Growth 2000-4	26	22	25	27	33	28	26
%Growth 2004-5	19	17	16	22	39	96	19

Notes: Panels report annual export value (in billions of dollars) and number of exporters by type of product and destination. NTC, OTC and MFA represent non-textile-and-clothing, other textile and clothing, and quota-constrained textile and clothing goods, respectively (see text). ROW refers to rest of world, while US/EU/Canada refers to exports to one of these three countries. Final rows of each panel report percent growth from 2000 to 2004 and from 2004 to 2005, respectively.

Table 1: Export Value and Number of Exporters, by Product and Destination

	Value Market Share, 2004						Total
	ROW			US/EU/Can			
	NTC	OTC	MFA	NTC	OTC	MFA	
SOE	0.26	0.28	0.32	0.21	0.44	0.54	0.26
Domestic	0.15	0.28	0.32	0.13	0.29	0.24	0.17
Foreign	0.58	0.44	0.35	0.65	0.26	0.23	0.57
Total	1.00	1.00	1.00	1.00	1.00	1.00	1.00

	Value Market Share, 2005						Total
	ROW			US/EU/Can			
	NTC	OTC	MFA	NTC	OTC	MFA	
SOE	0.23	0.24	0.27	0.18	0.36	0.38	0.22
Domestic	0.18	0.32	0.38	0.15	0.34	0.32	0.19
Foreign	0.60	0.44	0.35	0.67	0.30	0.30	0.59
Total	1.00	1.00	1.00	1.00	1.00	1.00	1.00

	Difference in Value Market Share, 2005						MFA
	ROW			US/EU/Can			
	NTC	OTC	MFA	NTC	OTC	MFA	
SOE	-0.04	-0.04	-0.05	-0.03	-0.08	-0.16	-0.04
Domestic	0.02	0.04	0.06	0.02	0.05	0.09	0.02
Foreign	0.01	0.00	-0.01	0.02	0.04	0.07	0.02

Note: Table reports export-value market share by type of firm, product and destination market in 2004 and 2005, as well as the change in market share between 2004 and 2005.

Table 2: 2004 versus 2005 Export Value Market Shares, by Type of Firm, Product and Destination

Margin	Single Difference				Triple Difference			
	All	SOE	Domestic	Foreign	All	SOE	Domestic	Foreign
Incumbents	<b>-0.210</b>	<b>-0.159</b>	<b>-0.033</b>	-0.018	<b>-0.167</b>	<b>-0.142</b>	<b>-0.022</b>	<b>-0.003</b>
Net Entry								
Exiters	-0.501	-0.323	-0.132	-0.046	<b>-0.024</b>	<b>-0.006</b>	<b>-0.010</b>	<b>-0.007</b>
Adders	<b>0.647</b>	0.260	<b>0.252</b>	<b>0.135</b>	<b>0.164</b>	<b>0.018</b>	<b>0.075</b>	<b>0.071</b>
New Exporters	<b>0.064</b>	0.003	<b>0.046</b>	0.014	<b>0.027</b>	<b>-0.002</b>	<b>0.025</b>	<b>0.005</b>
Total Net Entry	<b>0.210</b>	<b>-0.060</b>	<b>0.167</b>	<b>0.103</b>	<b>0.167</b>	0.009	<b>0.090</b>	<b>0.068</b>
Total	0.000	<b>-0.219</b>	<b>0.134</b>	<b>0.085</b>	0.000	<b>-0.133</b>	<b>0.068</b>	<b>0.065</b>

Notes: Left panel reports average change in 2004 to 2005 quantity-based market share across MFA-UEC product-country pairs by margin of adjustment and firm ownership type. Right panel reports average 2004 to 2005 versus 2003 to 2004 changes in MFA-UEC versus OTC-UEC quantity-based market shares across product-country pairs by margin of adjustment and firm ownership type. In both panels, rows 2 to 4 sum to row 5, and rows 1 and 5 sum to row 6. First column is sum of remaining columns. Results are generated using regression noted in text. Estimated coefficients are bold if they are statistically significant at the 10 percent level or better.

Table 3: Decomposition of Absolute and Relative 2004 to 2005 Changes in MFA-UEC Market Share

Margin	Single Differences				Triple Differences			
	All	SOE	Domestic	Foreign	All	SOE	Domestic	Foreign
Incumbents (I)								
Within	<b>-0.014</b>	<b>-0.009</b>	<b>-0.004</b>	-0.001	<b>-0.029</b>	<b>-0.017</b>	<b>-0.008</b>	-0.003
Across	<b>-0.019</b>	<b>-0.018</b>	-0.003	0.001	<b>-0.035</b>	<b>-0.025</b>	<b>-0.011</b>	0.001
Entrant (N)	<b>-0.045</b>	<b>-0.007</b>	<b>-0.030</b>	<b>-0.008</b>	<b>-0.065</b>	<b>-0.024</b>	<b>-0.026</b>	<b>-0.015</b>
Exiters (X)	0.003	0.005	-0.003	0.001	<b>0.040</b>	<b>0.026</b>	<b>0.020</b>	-0.005
Total	<b>-0.081</b>	<b>-0.038</b>	<b>-0.034</b>	<b>-0.009</b>	<b>-0.169</b>	<b>-0.092</b>	<b>-0.065</b>	-0.013
Extensive Share	0.59	0.32	0.79	0.95	0.63	0.54	0.70	0.82

Notes: Left panel reports average change in 2004 to 2005 export unit value across MFA-UEC product-country pairs by margin of adjustment and firm ownership type. Right panel decomposes 2004-5 versus 2003-4 relative changes in MFA-UEC versus OTC-UEC export unit value by margin of adjustment and firm ownership type. Rows 1 to 4 sum to row 5. First column is sum of remaining columns. Results are generated using regression noted in text. Final row reports the contribution of the extensive margin to the total price change of each column. Coefficients in bold are statistically significant at the 10 percent level or better.

Table 4: Decomposition of Absolute and Relative 2004 to 2005 Changes in MFA-UEC Unit Value

Ownership	Average Relative TFP	MFA-UJC		OTC-UJC	
		2004-05 Market Share Change	TFP Change	2004-05 Market Share Change	TFP Change
State-Owned Enterprises	0.82	-21%	-0.174	-11%	-0.088
Private Enterprises	1.76	13%	0.234	9%	0.155
Foreign Enterprises	1.54	8%	0.125	2%	0.030
Overall			0.185		0.097

Notes: Table decomposes aggregate productivity by ownership for MFA-UJC (panel 2) and OTC-UJC (panel 3). See text for a description of how productivity measures are calculated. The first column reports mean TFP relative to the industry mean for each ownership type. These averages correspond to the averages reported in the corresponding Figure. The 2004-05 changes in market share in the first column of panels 2 and 3 are taken from Table 2. The second and third columns in each panel multiply the change in market share with the average productivity measure. The final row in each panel is the sum of first three rows.

Table 5: Aggregate TFP Gain Following Quota Removal

	All Exports			Processing Exports		
	All	SOE	Domestic Foreign	All	SOE	Domestic Foreign
Margin						
Incumbents	<b>-0.167</b>	<b>-0.142</b>	<b>-0.022</b> -0.003	<b>-0.217</b>	<b>-0.150</b>	<b>-0.022</b> <b>-0.044</b>
Net Entry	0.000	0.000	0.000 0.000	0.000	0.000	0.000 0.000
Exiters	-0.024	-0.006	-0.010 -0.007	0.029	0.009	0.016 0.005
Adders	<b>0.164</b>	0.018	<b>0.075</b> <b>0.071</b>	<b>0.149</b>	-0.028	-0.009 <b>0.186</b>
New Exporters	<b>0.027</b>	-0.002	<b>0.025</b> 0.005	<b>0.038</b>	<b>0.011</b>	-0.002 <b>0.029</b>
Total Net Entry	0.167	0.009	0.090 0.068	0.217	-0.008	0.005 0.220
Total	0.000	-0.133	0.068 0.065	0.000	-0.158	-0.017 0.175

Notes: Table reports average 2004 to 2005 versus 2003 to 2004 changes in MFA-UEC versus OTC-UEC quantity-based market shares across product-country pairs by margin of adjustment and firm ownership type. The left panel re-produces the figures in Table 4, and the right panel is restricted to processing exports. In each panel, rows 3 to 5 sum to row 6. Final row is sum of rows 1 and 6. First column is sum of remaining columns. Results are generated using regression noted in text. Estimated coefficients in first five rows are bold if they are statistically significant at the 10 percent level or better.

Table 6: Decomposition of 2004 to 2005 Changes in *Relative* MFA-UEC Market Share, Processing Exports

Margin	All	SOE	Domestic	Foreign	All	SOE	Domestic	Foreign
Incumbents (I)								
Within	<b>0.073</b>	<b>0.033</b>	<b>0.019</b>	<b>0.020</b>	<b>-0.042</b>	-0.010	<b>-0.017</b>	<b>-0.015</b>
Across	0.007	0.003	0.002	0.001	<b>-0.032</b>	-0.013	<b>-0.011</b>	-0.008
Entrant (N)	<b>0.052</b>	<b>0.034</b>	0.005	<b>0.013</b>	-0.012	-0.005	-0.005	-0.003
Exiter (X)	<b>-0.119</b>	<b>-0.077</b>	<b>-0.033</b>	<b>-0.009</b>	0.022	-0.008	<b>0.028</b>	0.002
Total	<b>0.251</b>	<b>0.147</b>	<b>0.060</b>	<b>0.043</b>	<b>-0.109</b>	-0.020	<b>-0.061</b>	-0.028
Extensive Share	0.68	0.75	0.64	0.51	0.32	-0.16	0.54	0.17

Notes: Left panel reports average change in 2004 to 2005 estimated quality across MFA-UEC product-country pairs by margin of adjustment and firm ownership type. Right panel decomposes 2004-5 versus 2003-4 relative changes in MFA-UEC versus OTC-UEC quality by margin of adjustment and firm ownership type. Rows 1 to 4 sum to row 5. First column is sum of remaining columns. Results are generated using regression noted in text. Final row reports the contribution of the extensive margin to the total price change of each column. Coefficients in bold are statistically significant at the 10 percent level or better.

Table 7: Decomposition of 2004 to 2005 Changes in Absolute versus Relative MFA-UEC Quality

Embedded Institutional Reform

	Incumbent				Exiters			
	All	SOE	Domestic	Foreign	All	SOE	Domestic	Foreign
1{2005}	-0.0225	-0.0047	-0.0064	-0.0115	0.0213	0.0395	-0.0171	-0.0011
	0.0100	0.0075	0.0054	0.0053	0.0090	0.0091	0.0073	0.0057
1{MFA-UEC}	0.0261	0.0234	0.0013	0.0015	-0.0239	-0.0770	0.0217	0.0314
	0.0108	0.0090	0.0052	0.0045	0.0152	0.0135	0.0090	0.0056
x 1{2005}	-0.1672	-0.1418	-0.0222	-0.0032	-0.0243	-0.0065	-0.0103	-0.0075
	0.0173	0.0141	0.0084	0.0071	0.0158	0.0161	0.0125	0.0079
Constant	-0.0465	-0.0361	-0.0054	-0.0051	-0.4740	-0.2786	-0.1263	-0.0691
	0.0065	0.0050	0.0035	0.0032	0.0096	0.0078	0.0057	0.0042
Observations	5213	5213	5213	5213	5213	5213	5213	5213
R-squared	0.05	0.05	0.01	0.00	0.00	0.02	0.00	0.01
Single Difference	-0.210	-0.159	-0.033	-0.018	-0.501	-0.323	-0.132	-0.046
Double Difference	-0.141	-0.118	-0.021	-0.002	-0.048	-0.083	0.011	0.024

	Adder				New Exporter			
	All	SOE	Domestic	Foreign	All	SOE	Domestic	Foreign
1{2005}	0.0173	-0.0504	0.0604	0.0073	-0.0160	-0.0053	-0.0133	0.0025
	0.0091	0.0075	0.0071	0.0058	0.0055	0.0016	0.0045	0.0027
1{MFA-UEC}	0.0311	0.0596	-0.0087	-0.0199	-0.0334	0.0016	-0.0264	-0.0085
	0.0151	0.0132	0.0088	0.0067	0.0056	0.0022	0.0050	0.0019
x 1{2005}	0.1641	0.0175	0.0753	0.0713	0.0273	-0.0020	0.0248	0.0046
	0.0155	0.0138	0.0127	0.0088	0.0074	0.0024	0.0064	0.0031
Constant	0.4347	0.2329	0.1252	0.0765	0.0859	0.0089	0.0614	0.0156
	0.0093	0.0075	0.0052	0.0047	0.0041	0.0014	0.0036	0.0017
Observations	5213	5213	5213	5213	5213	5213	5213	5213
R-squared	0.05	0.02	0.05	0.02	0.01	0.01	0.01	0.00
Single Difference	0.647	0.260	0.252	0.135	0.064	0.003	0.046	0.014
Double Difference	0.195	0.077	0.067	0.051	-0.006	0.000	-0.002	-0.004

Notes: Notes: Table displays regression of change in noted quantity market share margin on noted dummy variables (see text), by firm ownership. Sample includes all product country pairs in groups MFA-UEC and OTC-UEC and years 2004 and 2005. Single difference refers to mean 2004 to 2005 change in quantity market share across product-country pairs in MFA-UEC. Double difference refers to the single difference mean less the analogous mean for OTC-UEC. Standard errors are adjusted for clustering at the eight-digit HS level.

Table 8: Regression Output for Table 3

	Incumbent - Within						Incumbent - Across					
	All	SOE	Domestic	Foreign	All	SOE	Domestic	Foreign	All	SOE	Domestic	Foreign
1(2005)	-0.0122	-0.0086	-0.0021	-0.0015	0.0019	-0.0030	0.0046	0.0003				
0.0082	0.0052	0.0036	0.0053	0.0088	0.0059	0.0029	0.0054					
1(MFA-UEC)	-0.0092	-0.0036	-0.0017	-0.0039	0.0012	0.0036	0.0027	-0.0050				
0.0070	0.0058	0.0033	0.0027	0.0078	0.0063	0.0026	0.0032					
x 1(2005)	-0.0287	-0.0171	-0.0083	-0.0033	-0.0351	-0.0252	-0.0109	0.0009				
0.0102	0.0073	0.0043	0.0055	0.0111	0.0082	0.0038	0.0059					
Constant	0.0357	0.0206	0.0078	0.0074	0.0127	0.0070	0.0010	0.0047				
0.0057	0.0047	0.0027	0.0023	0.0061	0.0051	0.0019	0.0027					
Observations	5105	5105	5105	5105	5105	5105	5105	5105				
R-squared	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00				
Single Difference	-0.0144	-0.0087	-0.0043	-0.0014	-0.0193	-0.0177	-0.0026	0.0008				
Double Difference	-0.0379	-0.0207	-0.0099	-0.0072	-0.0339	-0.0216	-0.0082	-0.0041				
	Entrant						Exit					
	All	SOE	Domestic	Foreign	All	SOE	Domestic	Foreign	All	SOE	Domestic	Foreign
1(2005)	-0.0283	-0.0135	-0.0115	-0.0033	-0.0338	-0.0200	-0.0024	-0.0114	-0.0724	-0.0451	-0.0114	-0.0159
0.0117	0.0080	0.0071	0.0055	0.0112	0.0081	0.0059	0.0042	0.0253	0.0156	0.0117	0.0095	
1(MFA-UEC)	-0.0148	-0.0006	-0.0072	-0.0070	-0.0242	-0.0095	-0.0075	-0.0072	-0.0470	-0.0102	-0.0136	-0.0232
0.0121	0.0092	0.0065	0.0057	0.0111	0.0085	0.0064	0.0041	0.0245	0.0168	0.0110	0.0088	
x 1(2005)	-0.0653	-0.0243	-0.0257	-0.0153	-0.0404	-0.0255	-0.0197	0.0048	-0.1690	-0.0921	-0.0645	-0.0128
0.0157	0.0109	0.0086	0.0071	0.0144	0.0113	0.0081	0.0053	0.0329	0.0220	0.0150	0.0118	
Constant	0.0638	0.0315	0.0143	0.0181	0.0952	0.0498	0.0330	0.0125	0.2070	0.1090	0.0560	0.0426
0.0088	0.0065	0.0056	0.0043	0.0086	0.0063	0.0046	0.0035	0.0186	0.0118	0.0085	0.0070	
Observations	5105	5105	5105	5105	5105	5105	5105	5105	5105	5105	5105	5105
R-squared	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.00	0.03	0.02	0.01	0.01
Single Difference	-0.0446	-0.0069	-0.0301	-0.0076	-0.0032	-0.0052	0.0034	-0.0013	-0.0814	-0.0384	-0.0335	-0.0093
Double Difference	-0.0801	-0.0249	-0.0329	-0.0223	-0.0646	-0.0350	-0.0272	-0.0024	-0.2160	-0.1023	-0.0781	-0.0360

Notes: Table displays regression of change in noted price margin on noted dummy variables by firm ownership. Sample includes all product-country pairs in groups MFA-UEC and OT-CUEC and years 2004 and 2005. Single difference refers to mean 2004 to 2005 change in quantity market share across product-country pairs in MFA-UEC. Double difference refers to the single difference mean less the analogous mean for OT-CUEC. Standard errors are adjusted for clustering at the eight-digit HS level.

Table 9: Regression Output for Table 4





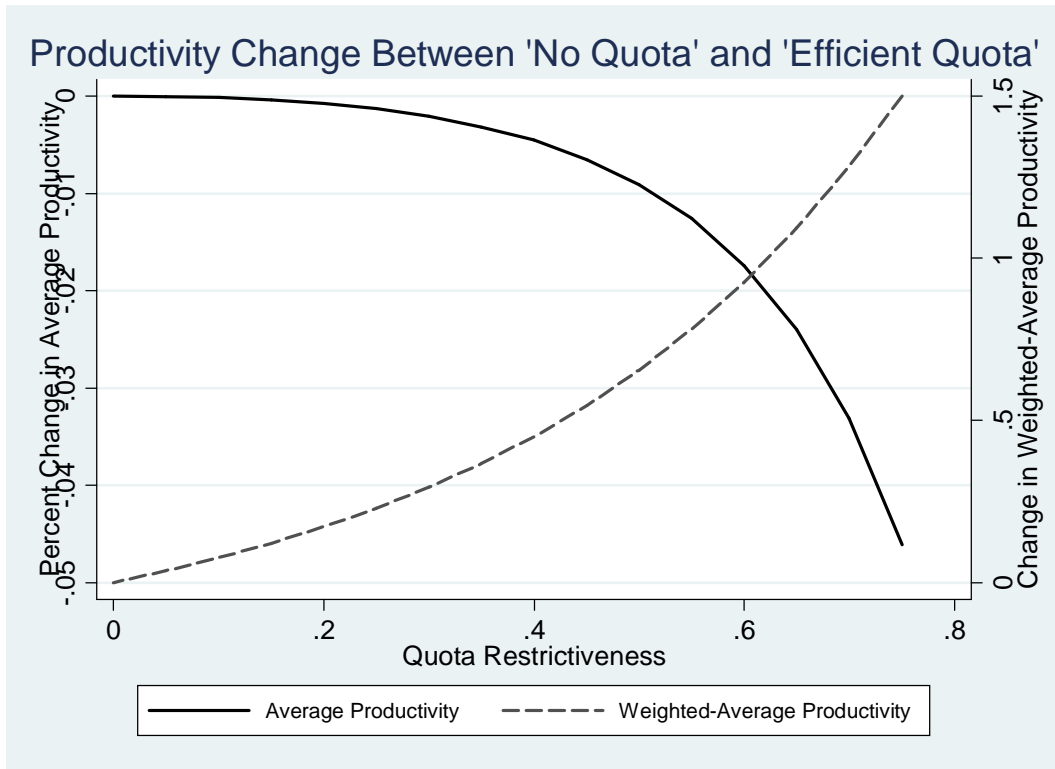


Figure 1: Numerical Solution: Change in Exporters' Average Productivity

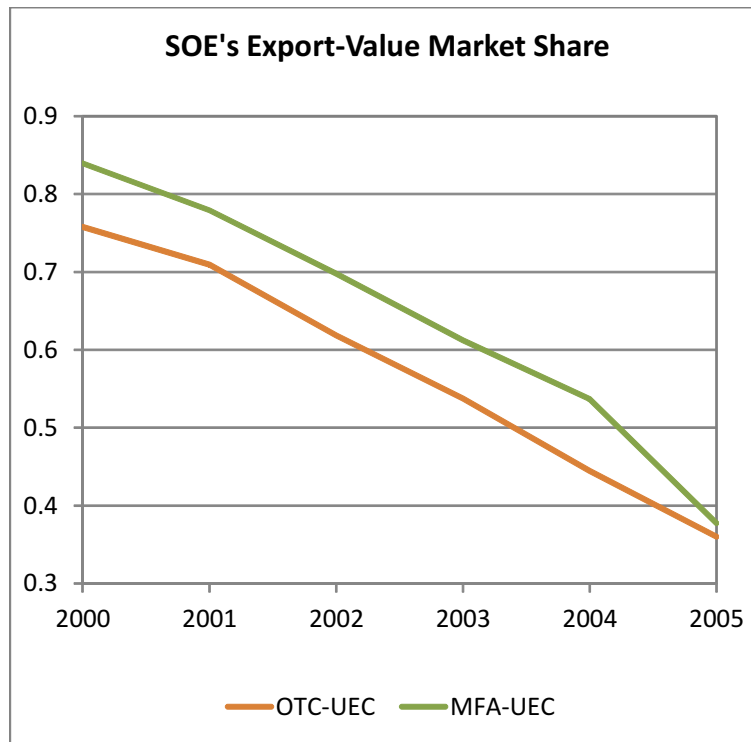


Figure 2: SOE Market Share by Year

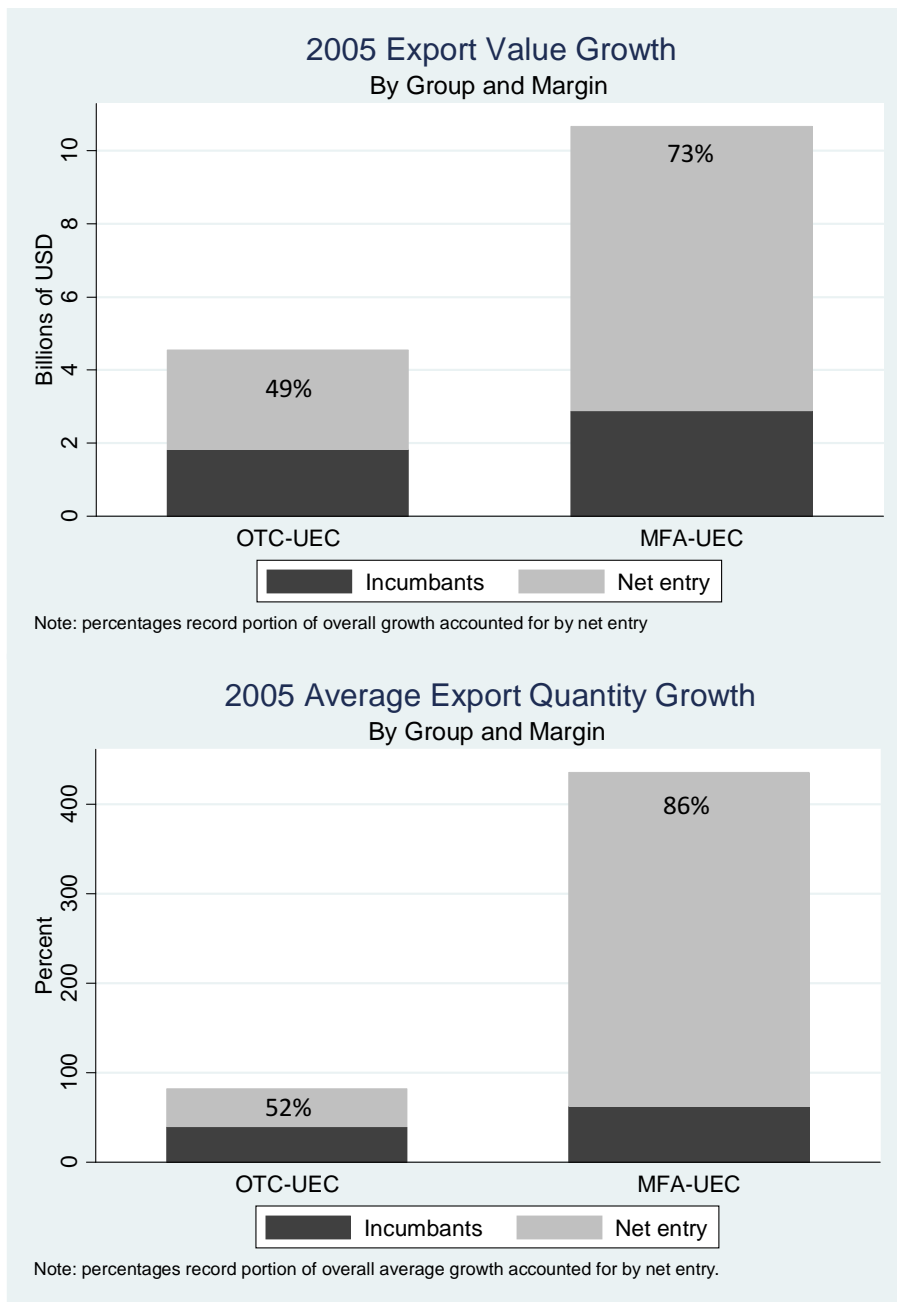


Figure 3: Export Growth by Year, Group and Margin

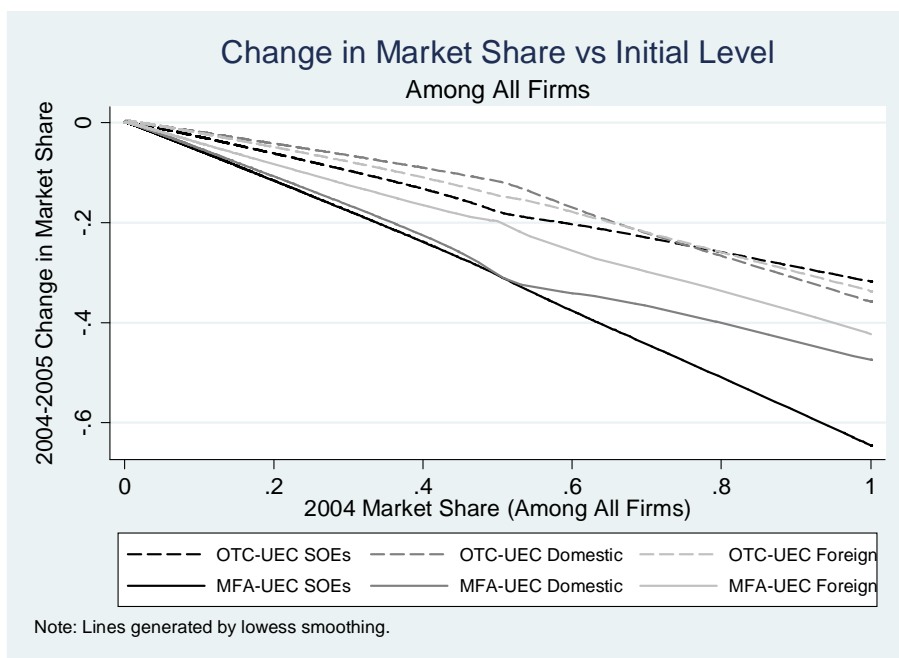


Figure 4: MFA-UEC Incumbents's 2004-5 Change in Market Share vs Initial 2004 Level

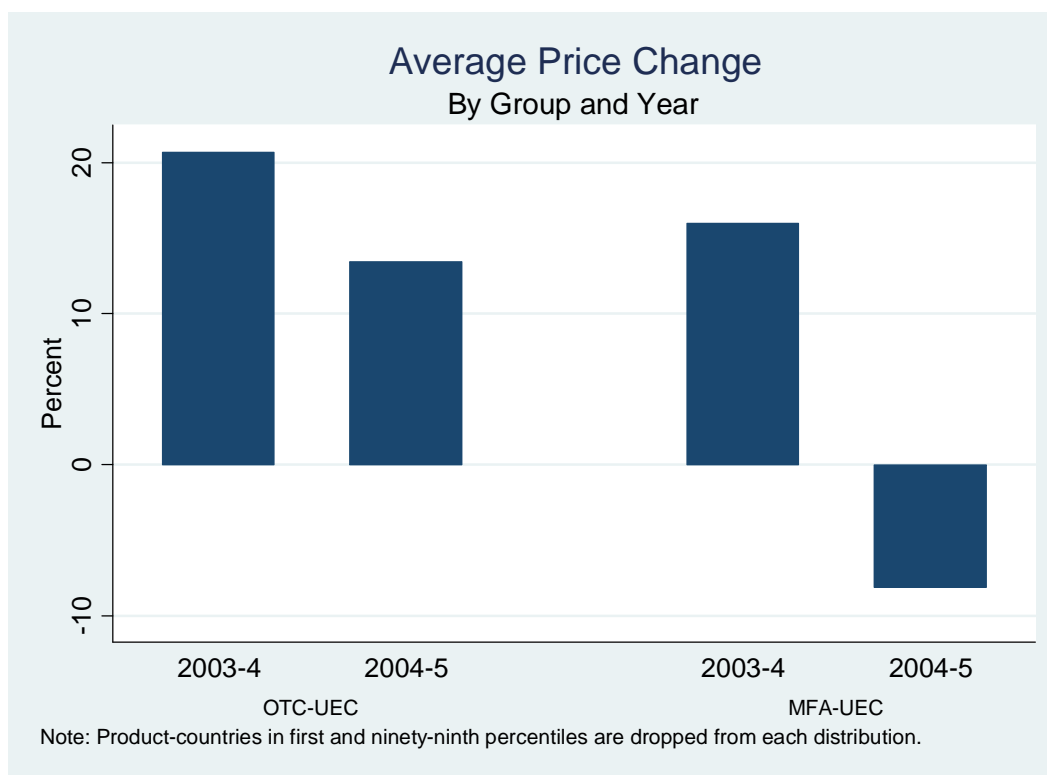


Figure 5: Average Export Price Growth Across Product-Country Pairs, by Group and Year

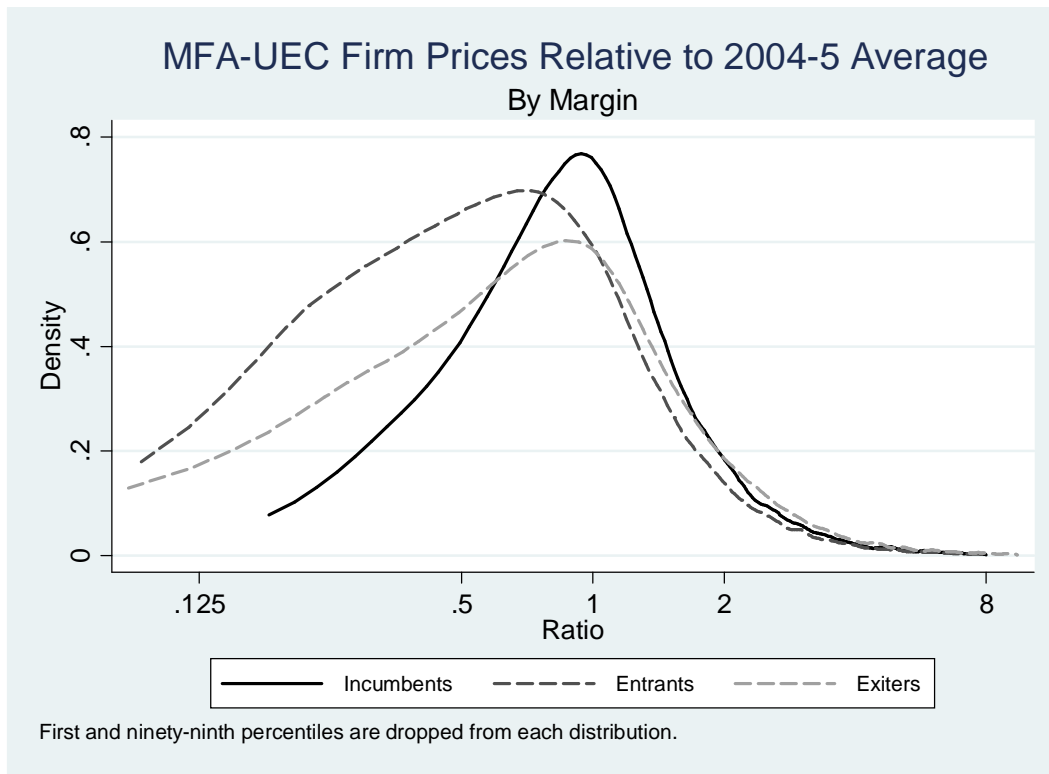


Figure 6: MFA-UEC Export Prices Relative to the Average Export Price Across All Firms in 2004 and 2005, by Margin

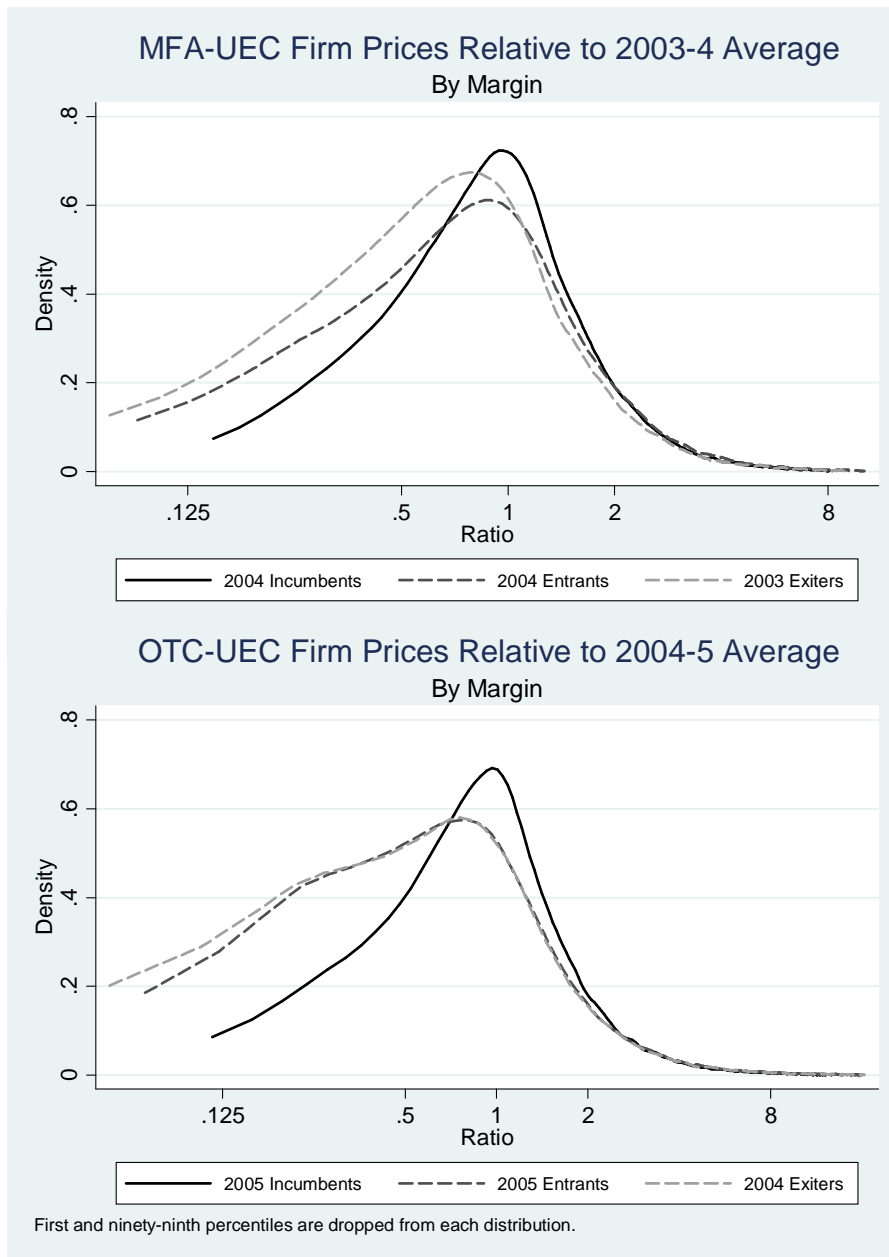


Figure 7: Exiters versus Entrants in 2005 OTC-UEC and 2004 MFA-UEC

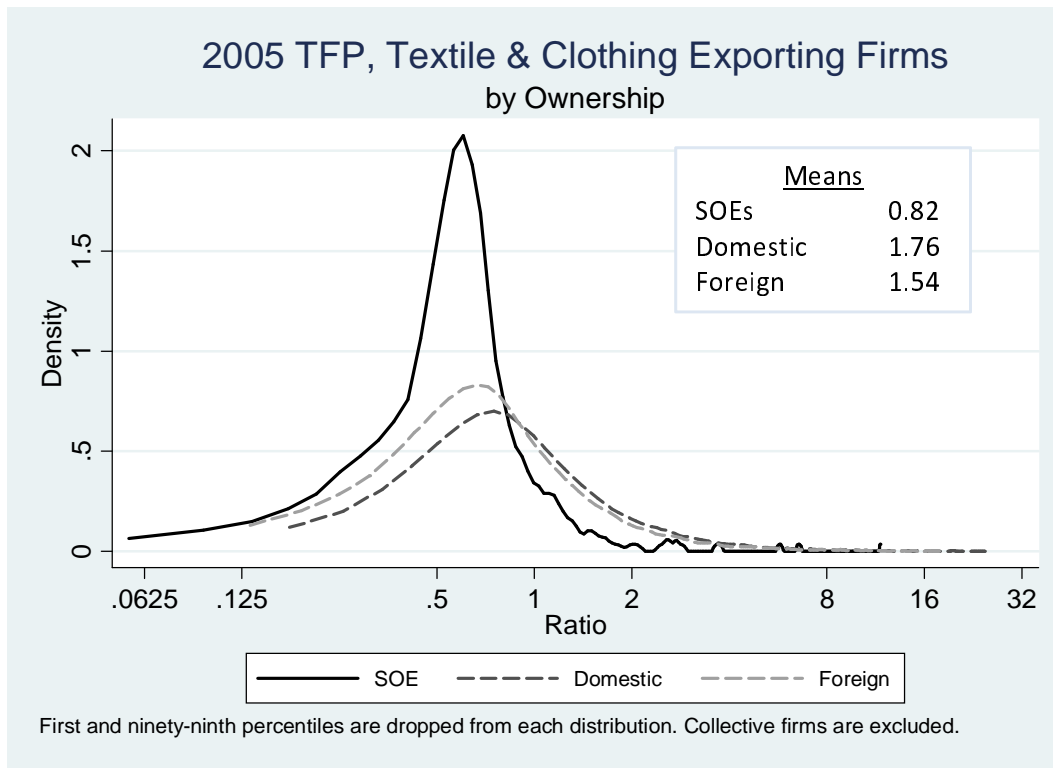


Figure 8: Textile and Apparel Producers' TFP, 2005



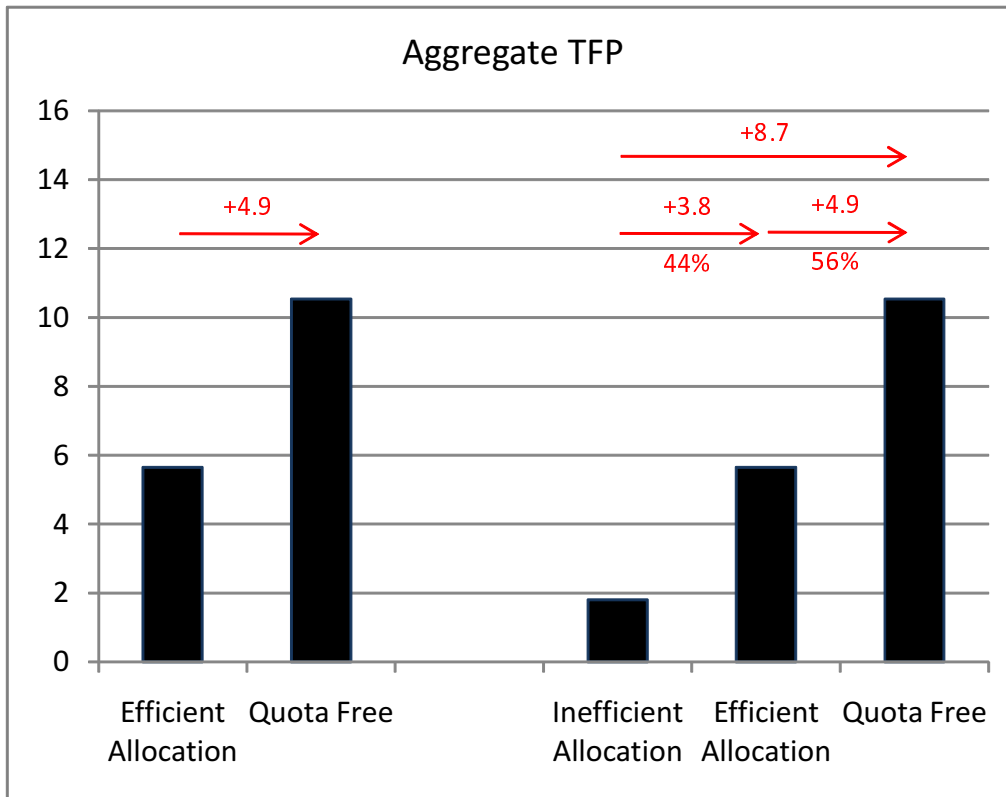


Figure 9: TFP Gains Implied by Efficient and Inefficient Allocation

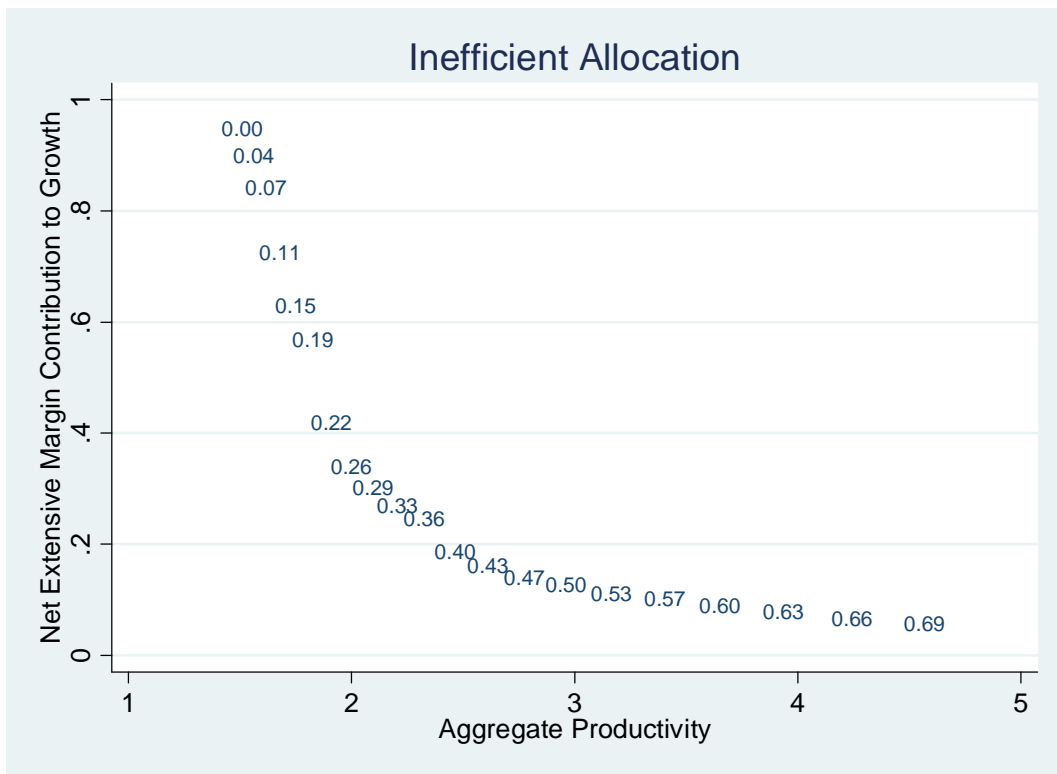


Figure 10: Counterfactual TFP under Inefficient Allocation